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COLONY AND PROTECTORATE OF KENYA.

Department of Agriculture Annual Report

MYCOLOGY

—

1926

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DEPARTMENT OF AGRICULTURE
ANNUAL REPORT 1926.

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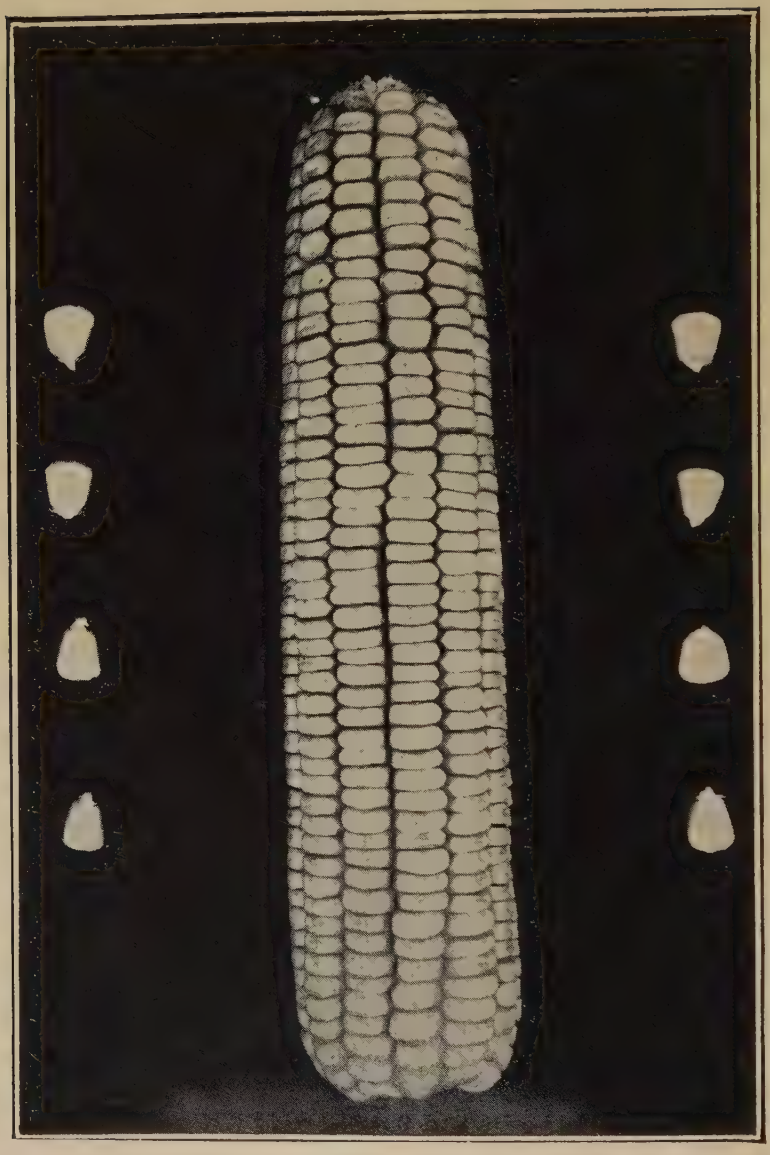


Type Cob of Kenya "Flat White (not yet named)" specially selected at Scott Agricultural Laboratories.

Annual Report of the Department of Agriculture.

FOR THE YEAR ENDED 31ST DECEMBER, 1926

REPORT OF DIRECTOR.

STAFF, ETC.

The remarks made in my last report in regard to the staffing of the Department still hold, and the services rendered continue along the lines therein indicated.

Every endeavour has been made to use the sanctioned appropriation to the best advantage by restricting to a minimum the amount spent on work which might be regarded as the least productive. The demands made upon the Department continue to increase to such an extent, and problems connected with production and the protection of the growing agricultural industry to such a degree, that it cannot be said that the establishment is adequate to cope with them.

The principal staff changes and new appointments are shown in Appendix A.

FINANCIAL.

Statements of Revenue and Expenditure for the Fiscal Year under review are given hereunder :—

EXPENDITURE.	Amount Sanctioned.	Amount Spent
	£	£
Administrative and General	19,981	18,375
Native Agriculture	11,804	9,209
Scott Agricultural Laboratories	6,948	8,344
Grading and Conditioning Export Produce	3,980	3,965
Contribution to Imperial Bureaux of Entomology and Mycology	450	450
Contribution to Amani Institute	1,200	—
Grant to Kenya Agricultural Society ..	500	500
Veterinary:		
(*a*) Administrative and Executive Division	23,744	21,523
(*b*) Native Reserves	11,052	10,460
(*c*) Central Training Depot	2,310	1,260
(*d*) Rinderpest Service	5,647	5,062
(*e*) Resarch Division	29,458	29,686
(*f*) Division of Veterinary Adviser	Nil	322
TOTAL AGRICULTURAL DEPARTMENT	£116,574	£109,156

REVENUE.	Original Estimates.	Actual Receipts.
	£	£
Agricultural Produce Grading and Inspection fees	4,300	5,046
Farm Produce and Stock	100	304
Veterinary Inoculation Fees	26,000	25,320
Sera, Vaccines and Laboratory Products..	7,000	4,712
Sale of Government Property and Stores	3,200	404
TOTAL AGRICULTURAL DEPARTMENT	£37,600	£35,786

The savings of £7,418 on the expenditure originally sanctioned were chiefly due to (1) lateness of appointments to fill vacancies, (2) the Veterinary Training Depôt not having been opened until late in the year, (3) the contribution to the Amani Institute not having been drawn.

The decrease in revenue of £1,814 against the original estimate was almost entirely due to the smaller orders placed by other countries for laboratory products, which could not be foreseen.

The net expenditure, as revealed by the above statements, amounted to £73,370.

The following statement shows the position in respect of expenditure and revenue during the last three years and for explanatory purposes it is divided under these heads :—

(1) Agriculture (including Headquarters Administration), Scott Agricultural Laboratories, Native Agriculture, Grading and Conditioning Services, Grants to outside bodies, etc.;

(2) Veterinary (Administrative and Executive Division);

(3) Veterinary Research.

	1924	1925	1926
	£	£	£
Agriculture (including Headquarters Administration)	16,980	17,080	17,140
Scott Agricultural Laboratories ..	4,297	6,065	8,344
Native Agriculture	6,092	11,016	9,209
Grading and Conditioning Services	1,429	1,080	3,955
Grants to outside bodies &c. ..	400	400	1,235
Gross Expenditure ..	31,198	36,441	39,893
Revenue	2,713	2,537	5,349
NET EXPENDITURE ..	£28,485	33,904	34,544
Veterinary (Executive Division) ..	30,409	37,026	38,027
Veterinary Research	20,600	27,743	29,696
Gross Expenditure ..	51,009	64,709	68,313
Revenue	18,864	31,002	30,032
NET EXPENDITURE ..	£32,145	33,707	38,281
TOTAL NET EXPENDITURE AGRICULTURAL DEPARTMENT	£60,630	67,611	72,823

GENERAL.

On account of the overlap between the agricultural and calendar year and inasmuch as the period covered by this report does not synchronise with that of the Agricultural Census there is some difficulty in reflecting the agricultural position.

The rainfall was generally above normal and on the whole it was a favourable season, though in some districts crops suffered from an excess of rain.

Of the main crops coffee showed some improvement over the previous season, and the condition of the trees gives promise of a heavy crop next season. The yields of maize were high in most districts, though disappointing in one or two on account of weather conditions.

Over the country as a whole fair crops of wheat were obtained.

The effect of varying seasonal conditions on sisal is but slight.

In the Native Reserves fears were entertained for a time in regard to food supplies but except in the eastern part of North Kavirondo crops were sufficient to ensure the sustenance of the people, until the new season's plantings were well advanced.

Market prices of some agricultural exports fell slightly towards the latter half of 1926, notably in the case of maize, coffee, cotton, and sisal, making it more than ever necessary that the costs of production should be closely watched.

To this end planters are studying economy in labour, also in methods and timely operations on the land in order to secure the best returns.

Increasing attention is being given to the mechanisation of farm operations, notably in the use of agricultural tractors, power machinery generally and labour-saving implements and appliances. Experience here, as elsewhere, points to agricultural tractors being regarded as an important and valuable adjunct to the draught ox, particularly on large holdings.

The prices of farm products consumed locally have shown further tendency to increase, and, particularly in the products of pastoral farming, they are high.

The apprehension indicated in my last report on account of labour shortage has been removed to an appreciable degree. African labourers have been offering their services in increasing numbers and it cannot be said that, except in rare cases, production and development suffered through an insufficiency of unskilled labour.

Towards the end of the year the Cold Storage Plant erected at Kilindini was put into commission, but demands on the part of the public for space are extremely small.

During the year the Colony received visits from authorities of distinction and their advice and assistance should prove of great value. Mr. A. D. Lewis, Director of Irrigation in the Union of South Africa, presented a comprehensive report upon the position in regard to irrigation and water supply.

Professor Sir Rowland Biffen made an extensive tour of the wheat-growing districts to advise upon the wheat industry with particular reference to plant-breeding services.

At the instance of the Committee of Civil Research, Dr. J. B. Orr, Head of the Rowett Research Institute, Aberdeen, visited the country with a view to examining the prospects for research work in connection with malnutrition and deficiency diseases, and as the result, experiments have been commenced at four centres upon the feeding of cattle and sheep, the cost, except in regard to local expenditure, being met from funds provided by the Home Government.

A creditable amount of research and experiment work has been carried out by the staff at the Scott Agricultural Laboratories and the Veterinary Research Laboratory, but it is desired again to emphasise the necessity for organising scientific and technical services in advance of the need. Problems continually arise which necessitate immediate consideration and with the present inadequate staff it becomes increasingly difficult to give them the attention that is required in the early stages. It is not always realised that the investigational work preliminary to the introduction of control measures in respect of pests and diseases necessarily occupies a considerable time, and if it is only begun when the menace becomes serious, heavy losses are inevitably suffered.

METEOROLOGICAL.

Again the financial provision allowed of nothing more than the upkeep of existing stations. The number of stations whose records are tabulated in the Meteorological Report, which is published annually, was 209. They are comprised as follows :

	Number of Stations
(*a*) Agricultural, Forestal, and Public Works	18
(*b*) District and Military	38
(*c*) Railway	19
(*d*) Private	134
Total ...	209

A summary of the meteorological records for 1925 is appended (Appendix N).

In order to ensure that records are being properly taken, and that sites of recording stations are well chosen, also that observations and records are made along standardised lines, it is very necessary that stations should be periodically inspected. More inspection than is at present possible is esential to ensure a fully efficient service.

In the course of a visit Dr. Hurst of the Physical Department, Egypt, enquired into the position regarding the organisation of the East African Meteorological Service, and proposals are under consideration whereby the central station may be established near Nairobi.

AGRICULTURAL STATISTICS.

The Seventh Agricultural Census for the period 1925-1926 was compiled and deals with :—

(*a*) Land under occupation and cultivation ;

(*b*) Main crops ;

(*c*) Animal husbandry ;

(*d*) Agricultural exports ;

(*e*) Wheat and wheat-milling statistics.

Arrangements were made for the introduction of a system of Crop Reports for European areas, whereby forecasts of production in the succeeding season can be made. That information should prove useful to the Railway Department and shipping companies, also to Government in reference to the economic position generally.

It is hoped to overcome certain difficulties which have arisen at the outset.

Imports.

The following table showing the quantities of foodstuffs imported in 1914 and also the past seven years, is of interest. They are for Kenya and Uganda. Separate figures are not available for Kenya.

IMPORTS—KENYA AND UGANDA.

	QUANTITY.								VALUE £							
	1926	1925	1924	1923	1922	1921	1920	1914	1926	1925	1924	1923	1922	1921	1920	1914
Wheat .. cwts.	2,821	2,635	1,993	1,983	900	1,352	337	5,585	2,612	2,524	1,623	1,590	879	1,900	515	3,001
Wheat Meal and Flour .. ,,	58,257	53,657	48,474	47,699	59,817	78,069	76,823	81,898	57,929	56,364	40,792	40,362	63,775	102,025	112,795	52,890
Ham & Bacon ,,	121	58	23	5	9	20	118	701	1,304	641	217	73	117	285	1,368	4,256
Butter .. lbs.	2,576	2,688	1,120	560	4,032	11,081	3,890	34,997	275	283	122	74	412	1,383	515	1,972
Cheese .. ,,	13,216	3,854	3,248	1,456	1,792	2,561	12,636	38,836	1,397	401	292	180	201	354	922	1,820
Ghee .. cwts.	7,099	7,309	8,592	5,233	4,209	1,878	600	2,347	49,838	42,685	28,740	13,717	14,631	13,900	3,510	8,702
Condensed Milk ,,	8,009	6,258	5,352	3,105	1,305	4,560	5,210	9,468	29,132	22,990	20,851	11,912	5,247	25,076	22,554	20,498
Sugar .. ,,	19,567	27,161	27,446	31,632	69,212	65,958	47,921	74,485	20,265	31,475	42,049	54,041	89,405	129,869	167,554	54,829

The total value of these imports, representing articles of food which might be produced locally, amounts to £163,432, an increase of £6,069 over last year, increases being shown in such items as flour, bacon, cheese, tea and condensed milk, with however a noteworthy reduction in the quantity of sugar imported.

Exports.

The total value of agricultural exports, the produce of Kenya, in 1926 was £2,211,665, a decrease of £83,034 compared with the previous year. The tonnage was 85,444 tons in 1926 against 98,912 tons in 1925. This decrease is almost entirely due to a falling off in the quantity of maize exported, which decreased by £125,707 or 12,169 tons.

Cotton exports show a decrease of 11 per cent.

Figures quoted hereinafter show the progress of agricultural development. In the absence of an unfavourable season and serious fall in market prices, the quantities and values of agricultural exports will again show a substantial increase.

Acreage and Occupation.

The total area allotted for occupation by Europeans is approximately 5,000,000 acres, and in addition to this an acreage of about 2,000,000 acres is available for alienation. Of the area allotted 4,587,817 acres are in occupation, showing an increase of 167,244 acres over the previous year. The number of occupiers totals 1,809, or an increase of 114 over the previous year. The total area cultivated is 463,854 acres, giving an average of 286 acres per occupier, against 232 and 154 acres for the years 1925 and 1921 respectively. Including the development through livestock, on a basis of six acres per head for cattle and three acres per head for small stock, the average development by each European occupier is 1,311 acres which shows the extensive character of farming operations in this Colony.

The figures for individual crops show that the areas under maize, coffee, sisal, wheat, sugar cane and barley are increasing. Further particulars of crop production and livestock will be found under appropriate headings in this report.

Main Crops.

On July 31st, 1926, the total area under crops—European—was 401,041 acres, and the total area under cultivation was 463,854 acres. For comparative purposes figures for the

previous year are given and the percentages of increase and decrease are shown :—

Crop.	1926 Acres.	1925 Acres.	Increase per cent	Decrease per cent
Maize	193,187	155,916	23.9	—
Wheat	43,765	21,085	107.5	—
Barley	2,644	950	178.3	—
Coffee	68,950	65,140	5.9	—
Sisal	60,197	52,872	13.9	—
Tea	1,689	382	342.1	—
Coconuts	8,766	8,971	—	2.3
Sugar Cane	6,747	6,556	2.9	—
Miscellaneous	18,525	18,654	—	0.7
Total acreage of crops grown	404,460	330,144	22.5	—
Less Catch Crops	3,427	5,813	—	41.0
Net area under Crops ..	401,041	324,331	23.7	—

That statement discloses markedly satisfactory progress.

Maize.

The season's figures reveal an increase of 23.9 per cent. in the area planted as at 31st July, 1926 (193,187 acres), though it should be noted that some of the increase is accounted for by the alteration of the date of the census return figures from 30th June to the 31st July.

The average yield of maize over the whole country is about six bags per acre.

The following table showing acreages and yields of maize in past years is of interest :—

Year.	Acreage Harvested. Acres.	Actual Production. Bags.	Bags per acre
1922–1923	74,747	517,877	6.23
1923–1924	108,556	833,640	7.68
1924–1925	129,647	893,108	6.89
1925–1926	155,751	826,614	5.95

Officers of the Department have again given attention to the selection of maize in the field, particularly on farms in the Nakuru district, and already good results have been obtained.

In addition some breeding and selection work is being done at the Scott Agricultural Laboratories. From a selection of ears originally secured from Mr. A. B. Simpson, Nakuru, a breeding plot was planted in 1925. At the same time the yielding power of this specially selected maize was tested against other varieties with results as shown in the table

appended. From a further selection of the crop of 1925 a larger breeding plot was planted in 1926. The photographs herein reproduced show that crop and ears selected from an area of only *two-thirds* of an acre.

An attempt is thus being made to fix a type of " Flat White " maize possessing both high yielding power and high commercial quality. The yielding power was demonstrated in the experiment mentioned, from which it will be seen that grown under exactly similar conditions the yield from the " specially selected " was 3,360 lbs. per acre against 1,920 lbs. per acre of a crop grown from good seed of the " Flat White " type ordinarily grown in the country. The type and productive capacity are being established as fixed characters through detasselling the male flowers of weak plants, the marking of good plants and the selection of ears for seed purposes from those marked plants only.

Steps will be taken to multiply seed and it is hoped that in due course a quantity of seed of this variety (yet unnamed) will be available for distribution.

MAIZE VARIETY TRIALS.

SCOTT AGRICULTURAL LABORATORIES, 1925.

No.	Name	Description	Planted	Harvested	Period on Land	Yield per acre	Remarks.
1	Wisconsin No. 8 ..	Yellow Dent ..	23/4/25	23/9/25	153 days	2,000 lbs.	Medium Stand—Local seed.
2	Yellow Cango	Yellow Flint ..	do.	18/10/25	173 days	600 lbs.	Low Stand—Imported.
3	Eureka	Yellow Dent ..	do.	do.	do.	1,400 lbs.	Medium Stand Imported.
4	White Cango	White Flint ..	do.	do.	do.	2,000 lbs.	Low Stand—Local seed.
5	Potchefstroom Pearl ..	White Dent ..	do.	28/10/25	195 days	1,600 lbs.	High Stand—Local seed.
6	Kenya " Flat White" ..	do.	do.	do.	do.	1,920 lbs.	do. do.
7	Kenya " Flat White" " Special Selected " ..	do	do	2/11/25	200 days	3,360 lbs.	Very high stand—strong growth of stem and leaf Local seed.

Greater interest is being taken in the maintenance of soil fertility by means of the application of manures, and the introduction of rotations including green manures, on which experiments are being undertaken by the Agricultural Chemist and by whom advice is being given.

The Fourth Maize Conference was held at the offices of this Department and the report of its deliberations was duly published. The chief recommendations were as follows :—

(*a*) That the charges for conditioning maize when consigned to the conditioning plant direct be reduced from 60 cents to 50 cents per bag, but that preference be given to maize rejected in the process of grading;

(*b*) That the profits (if any) derived from grading fees be utilised towards meeting any losses incurred in the conditioning services or *vice versa*;

(*c*) That the Grading of Maize Rules, 1925, be amended to provide for the shipment of maize in bulk and the use of second-hand bags for that purpose;

(*d*) That the Honourable Director of Agriculture takes action with the Railway authorities, under the appropriate Ordinance, for controlling the transportation of maize intended for export from Kavirondo, until a prescribed date in each year;

(*e*) That a plant-breeder solely for maize be appointed.

Action has been taken with regard to each and every one of these recommendations.

During 1926 the total number of bags offered for grading was 542,852, being 77,000 bags less than the number in 1925. Of the total it is estimated that 120,000 or 24 per cent. of the maize emanated from Native sources. In addition to the above, 68,000 bags were shipped, without grading certificates, to African ports as provided by Rule 25 of the Maize Grading Rules. Of the graded maize 49,336 bags were rejected as wet; 8,802 rejected as musty; 20,384 as weevilly; and 7,568 rejected from other causes, giving a total of 86,090 rejected.

There has been an innovation in the bulk shipment of maize. Special provision was made by amendment of the Grading Rules to enable maize in second-hand bags to be graded, and for these bags to be emptied in the holds. 69,000 were so shipped, and the bags returned to the consigners. A total of 106,000 bags was conditioned during the year, and the plant had to be worked at very high pressure during the last quarter.

Standard samples in accordance with the several grades were prepared and distributed as in former years.

Wheat.

The area as at 31st July, 1926, was 43,763 acres, a very significant increase as compared with the previous year. The acreage harvested in each year and the production during the past few years are as follows :—

Year.	Acreage harvested. Acres.	Actual production. Bags.
1922–1923	15,158	35,793
1923–1924	19,599	55,920
1924–1925	23,996	61,067
1925–1926	30,627	80,069

Though good yields are obtained in individual cases, the average still remains low. The advantage possessed by wheat in respect of ease of handling and low labour requirements, together with the comparatively high price of Sh. 20/- per bag of 200 lbs. realised, have greatly stimulated wheat production.

With continued progress for another year or two the acreage of wheat planted producing a normal crop should be sufficient to satisfy the needs of this Colony and neighbouring territories in respect of wheat and wheat flour. The establishment of a Wheat Growers' Association is timely and it will have an opportunity of rendering a valuable service to the industry by acting as a connecting link between miller and grower and by removing difficulties which exist in the storage and marketing of the grain. In other directions this Department hopes to co-operate with the Association in work of benefit to all of those engaged in the industry.

Reference is made under "Plant-breeding" to the important work which is being done in the raising of rust-resistant wheats possessing not only that character but the high yield and good milling qualities. Substantial progress has been made and the expectation is that, within a few years, the industry will be placed in a more secure position through the introduction of those qualities essential to successful culture in this region.

For the first time a census of wheat mills and wheat milling was taken during 1926 and furnished the following information :—

There were eight wheat mills operating during the year. The eight mills are capable of milling a total of 47.5 bags (200 lbs.) wheat hourly. 63,511 bags wheat were milled during the year, producing 16,550 bags (200 lbs.) fine flour and 27,085 bags (200 lbs.) atta flour.

The wastage in milling was 19,876 bags of 200 lbs. or 31.29 per centum of the total quantity milled.

Barley.

Greater interest is being taken in this crop, there being 2,644 acres planted in 1926 as against 950 acres in 1925.

Coffee.

The season has, on the whole, been good, especially in the largest coffee-producing areas. On some estates a proportion of the crop was lost through shortage of labour. There was an increase of 5,757 cwts. in the quantity of coffee exported, the result showing an increase in export value from £723,180 to £747,453 in 1926. The acreage increased from 65,140 acres in 1925 to 69,950 in 1926.

The industry, which is the most extensive in the country, provides 32.5 per cent. of the total value of agricultural exports, and 39 per cent. of the European occupiers were coffee planters, numbering 714.

It is to be observed that the production of coffee has not increased in proportion to the increase of acreage coming into bearing. This may be accounted for by a number of factors, the chief being shortage of labour. Many thousands of acres of coffee are not being properly pruned with consequential reduction in the average yield. Again large areas have been stumped, and these are non-productive for two years afterwards. Further, there was considerable loss in production, as the crop was not fully picked, and on account of the dry years experienced in 1924 and 1925 the growth of new bearing wood was affected.

During the year the Senior Coffee Officer visited 149 plantations and had 304 interviews in his office. Tours of instruction were arranged in conjunction with the Coffee Planters' Union, and a number of pruning and other demonstrations were given on individual plantations. 4,553 miles were travelled on Government duty and the officer was absent for 104 days from headquarters.

The introduction of "Robusta" coffee has received serious consideration and thereon the Coffee Planters' Union has been consulted. It was seen that in the Highlands area the conditions were not likely to prove favourable to the growth of this type and there appeared to be a risk of damaging the quality and the reputation of "Arabica," now firmly established. But it was decided to carry out trials of "Robusta" types as well as "Liberica" along the coast, in co-operation with planters. Attempts previously made to introduce coffee seed with safety failed, but a number of plants of each type were secured for trial purposes from the Amani Institute, and kept under observation at the Scott Agricultural Laboratories until distributed.

Reference is made under "Entomology" and "Mycology" to coffee pests and diseases.

During the period under review thirty-one plantations were examined by the Inspector of Plantations, but that work was interrupted during the period of his absence on leave and again when he was called upon to act for the Mycologist.

Notices were served upon fifteen occupiers of coffee plantations under the Diseases of Plants Prevention Ordinance.

There is a pressing need for more entomological research work and a systematic inspection of plantations, for neither of which is the existing staff nearly adequate to protect the industry. In my last report the necessity of departmental services being rendered in advance of the need was urged, and that is exemplified in the difficulty which arises when a disease or pest becomes epidemic in character—the case of " mealy bug " may be quoted—and very serious losses are suffered before satisfactory control measures can be devised, as the result of extensive investigations necessarily occupying a considerable time.

Sisal.

The industry is in a flourishing condition. The total area planted as at 31st July, 1926, was 60,197 acres, of which 36,538 acres were over three years old and therefore available for cutting.

The increase in area for 1926 is 7,325 acres or 15.85 per cent. over the previous year.

In exports of fibre the quantity has risen from 287,260 cwts. in 1925 to 294,568 cwts. in 1926. The value being up £48,370 at £579,499.

The sisal industry is under the control of energetic business men and planters and unceasing efforts are made to improve methods and systems. The efficiency of labour on sisal plantations shows a gratifying advance, largely due to sound organisation, to which the industry lends itself.

Coconuts.

There was a decrease in the export of copra, from 31,298 cwts., valued at £35,915, in 1925, to 22,085 cwts., valued at £25,765, in 1926. The fall in exports during the last two years is due to the increasing extent to which copra is used locally for soap manufacture. There is no marked change in the area of coconut plantations.

Sugar Cane.

There has been an increase only of 191 acres planted as at 31st July, 1923, bringing the total area planted to 6,747 acres. The production of sugar is steadily increasing.

The incidence of " mosaic disease " has been further investigated during the year, and legislative action was taken under the Diseases of Plants Prevention Ordinance prohibiting

the planting of other than the Uba variety within a prescribed period, with the object of endeavouring to eradicate the disease from the one district affected.

NATIVE AGRICULTURE.

The agricultural officers of this department have, during the period under review and under instructions, acted mainly in an advisory capacity to the administration, direct contact with native workers being achieved through the organisation of the training schools and farms. The effort has been primarily educational, directly through the training farms, and more generally by means of demonstration plots in various locations.

Mass issues of seed have been made, and training in hide preparation has been given. Under the head of " Veterinary Services " reference is made to cattle inoculations, etc.

The distribution of the staff engaged in native agriculture was as follows :—

Nyanza.—Two agricultural officers regularly, and one part time, with sixteen native instructors, one stock inspector (veterinary), with instructors in hide preparation.

Kikuyu.—Two agricultural officers regularly, and one part time, with eighteen native instructors.

Coast.—One agricultural officer with ten native instructors.

Two agricultural officers were on leave the greater part of the year, and one post was vacant.

At the schools for agricultural training, the average number of pupils was 46 at Bukura and 39 at the Scott Agricultural Laboratories.

During the year 14 pupils who have completed their training have been found employment as native instructors in the reserves.

In addition a considerable number of veterinary staff were employed in the native areas. Particulars thereof will be given under " Veterinary."

Weather Conditions.

Nyanza.—The rainfall was much above the average with but a very slight break between the long and the short rains. Crops suffered as a consequence and yields have been low. Fever amongst the inhabitants restricted the amount of work done, particularly towards the end of the year. These factors have reduced the output of marketable crops, and in some areas a food shortage may result.

Kikuyu.—Extremely heavy rains were experienced in March and April. On the whole the conditions were favourable.

Coast.—With the exception of certain parts of Digo and Kilifi districts the rainfall was sufficient and a fairly good season was experienced.

On the whole the year was not above the average and an increased output of native products is not expected.

Issue of Seed.

These were again made in most reserves and an effort was made to induce natives to purchase seed for themselves. As yet, however, a native does not feel inclined to spend money on seed for his own " shamba." Local Native Councils have, however, provided funds for the purchase of seed for distribution within their own areas generally to augment the department's contribution.

The surplus of seed produced at Bukura and the Scott Agricultural Laboratories, together with the production from the demonstration plots was issued free.

The following table shows the quantity, variety and distribution of seed during the year. That these seed issues are making their influence felt in native crops is manifest, though it is realised that in some cases irregular use is made of it and there is some wastage.

DISTRIBUTION OF SEEDS TO NATIVE RESERVES, 1926.

STATION.	Maize	Beans	Wheat	Cotton	Ground-nuts	Simsim	Rice	Vege-tables	Potatoes	Buck-wheat	Tobacco	Mtama and Millet	Pigeon pea
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
KERIO PROVINCE	120	120	—	—	—	—	20	2	104	—	9½	180	20
Kolosia	120	120	—	—	—	—	—	2	—	—	8	—	20
Baringo	—	—	—	—	—	—	20	—	104	—	1½	—	—
KIKUYU PROVINCE	3,168	487	2,410	—	1,600	60	20	—	620	437	—	—	—
Embu	2,400	—	1,160	—	1,600	60	20	—	—	—	—	—	—
Keruguya	20	60	60	—	—	—	—	—	—	60	—	—	—
South Nyeri	300	180	—	—	—	—	—	—	180	180	—	—	—
Kyambu	448	247	1,190	—	—	—	—	—	640	197	—	—	—
NYANZA PROVINCE	18,000	200	—	44,800	—	—	2,240	—	—	—	—	—	—
Central Kavirondo ..	—	—	—	44,800	—	—	—	—	—	—	—	—	—
North Kavirondo	16,000	—	—	—	—	—	2,240	—	—	—	—	—	—
Nandi	2,000	200	—	—	—	—	—	—	—	—	—	—	—
UKAMBA PROVINCE ..	—	4,000	—	—	2,250	2,250	—	—	—	—	—	—	—
Machakos	—	4,000	—	—	2,250	2,250	—	—	—	—	—	—	—
COAST PROVINCE	5,400	1,400	—	56,600	—	8,250	800	—	—	—	—	—	—
Digo	3,600	400	—	4,600	—	2,700	800	—	—	—	—	—	—
Malindi	—	1,000	—	50,000	—	4,500	—	—	—	—	—	—	—
Kilifi	1,600	—	—	—	—	750	—	—	—	—	—	—	—
Mombasa	200	—	—	2,000	—	300	—	—	—	—	—	—	—
NORTHERN FRONTIER PROVINCE	400	120	180	—	—	—	—	—	—	60	—	180	—
TOTAL PROVINCIAL ISSUES	27,088	6,327	2,590	101,400	5,850	10,360	3,080	2	924	497	9½	180	20

Implements, Etc.

Progress in the use of labour-saving appliances has been noticeable particularly in the Nyanza Province, though in other areas the movement has also been started. In Nyanza, 87 ploughs, 227 grist mills and 23 sets of mill stones were procured in 1926 by the more intelligent natives. There are great opportunities for native enterprise to effect large savings in man-power by providing small ox-carts for the transport of their produce to rail and market, and some progress along these lines is being made, notably in the Kikuyu Province. It should be within their means, with the assistance of the Native Councils, to organise the service and thus effect great savings. There is great scope for the economic and profitable use of implements and transport vehicles in native reserves, but the natives themselves are slow to take advantage of them. Influence exerted in past years through different agencies is beginning to show results, but encouragement is still required and the native may have to be persuaded to exercise perseverence in the use of these adjuncts to his individual effort.

Maize.

In order to introduce a good type of maize in an extensive area to be served by the new railway line, the main issue of seed of " Flat White " was made in North Kavirondo. With the advent of the railway through the Kikuyu country, in which issues of maize of this type were made in previous years, a new source of supply was tapped and considerable quantities were exported therefrom, but both here and in Kavirondo difficulties were experienced. On account of the wet season the moisture content was in excess of the limit for export purposes, and with attendant risks of rejection and costs of conditioning, buyers offered lower prices to the native producer. An attempt was made to reduce the quantity of wet maize offered for grading by the promulgation of a rule under the Crops Production and Livestock Ordinance of 1926, whereby maize from Kavirondo could not be transported by rail before the 5th September. It is reported that the rule was not entirely successful in its object as the wet maize was held up at the trading centres in the reserve until the due date. It is a comparatively simple matter for the small trader to overcome the difficulty, either by refusing to buy wet maize from the native grower, or to expose the grain to the sun for a few days before bagging it up for railage to the Coast.

On the Coast issues were made in the Digo and Kilifi districts and good yields were reported.

Cotton.

Twenty tons of selected Uganda seed were issued from the Sio Ginnery in Central Kavirondo. Issues of local seed were made from other ginneries and buying centres. Natives do not take the seed freely and require urging to do so. Unless

administrative officers constantly point out the utility of the crop and advise natives to plant it they are prone to neglect it. That effort should be made early and continued until the planting season closes. Again, at this stage of development it is essential that natives should be encouraged to realise the need to pick cotton cleanly and regularly.

For the crop planted in 1925 the price for the best " seed cotton " varied from 19 to 25 cents. The purchases of " seed cotton " in Nyanza were as follows :—

North Kavirondo	...	...	1,428,110 lbs.
Central Kavirondo	...	...	1,022,913 lbs.

Great dissatisfaction with the prices paid was shown by the native growers and as a result a much smaller acreage was planted in 1926. Yields were poor, due largely to the general indifference shown by the natives towards the crop. An endeavour should be made to overcome this as good returns can be obtained from a crop to which proper attention is given.

On the coast the price paid for the crop planted in 1926 varied from 9 to 10 cents per lb. Owing to bad germination and the depredations of pink boll-worm the yields were poor. The total amount of seed cotton purchased in this area during the year was 108,000 lbs.

The total production of lint for the whole Colony during 1926 was 2,046 bales of 400 lbs. each.

Simsim.

The acreage under this crop is increasing, particularly in parts of Kavirondo where it is tending to displace cotton. It is very well suited to native agricultural practice, and has the added merit of being useful for food. As it is considered that this crop is one well suited to coastal conditions, large issues of seed were made therein, and the results are promising.

72,103 cwts. were exported from the Colony in 1926.

Groundnuts.

Issues of groundnut seed were made in the Embu and Machakos areas, but the crop does not seem to commend itself to the native grower. Demonstrations were given in Embu in the preparation of " groundnut butter " in order to aid in popularising the crop.

Buckwheat.

Large numbers of requests for seed were made which could not be met. The cultivation of the crop is being seriously undertaken by the natives. It has proved most suitable in the drier areas and on account of its rapid growth and utility for food purposes it is a valuable crop when famine conditions are threatened.

Rice.

One ton of seed was distributed in North Kavirondo and good yields were obtained. Many attempts have been made to establish the crop in the Mumias area, and it is hoped natives will persevere in growing it where conditions are favourable.

The establishment of a rice mill at Njoro provides a good market for the crop, and removes the difficulty of hulling previously experienced.

On the coast an increased acreage was grown in the Kilifi area, but the crop on the alluvial soils along the rivers of the coastal belt is a precarious one, and it would appear that irrigation schemes are an essential preliminary to success.

Wheat.

Issues have been restricted as the native areas are subject to rust, as elsewhere, and failures would deter its introduction at a later stage when the seed of more rust resistant varieties is available. It is realised that wheat would form a valuable addition to the diet of the native and that his nutrition would thereby be improved.

Native Agricultural Shows.

During the year seven Native Agricultural Shows were held. In Nyanza at Maseno and Mumias; in Kikuyu at Embu; in Ukamba at Machakos; on the coast at Kilifi, Malindi and Kwale.

The grants-in-aid made by the Department totalled £225. The prizes consisted of medals, small agricultural implements, and small sums of money.

A marked improvement in the quality of the exhibits was again noticed and though the average number of exhibits was lower than those of last year, this was due almost entirely to the elimination of poor exhibits.

The value of these shows is great and they often bring to light the possession of varieties of crops of which little is known.

Native Live Stock.

There is little evidence to show to what extent stock in the possession of natives are increasing. It can safely be assumed that they are not decreasing and the following figures are believed to represent the number of each class of live-stock :

Cattle	3,200,000
Sheep	2,550,000
Goats	3,550,000
Horses	200
Mules	300
Donkeys	35,000
Camels	60,000

The abnormally high prices realised for cattle in the previous year, both for slaughter and draught purposes were not maintained. Prices fell a little, but they still remain far beyond the true value of the stock.

As revealed in the report of the Veterinary Department, natives are taking advantage of facilities afforded for the protection of their cattle against rinderpest and pleuro-pneumonia, and according as that effort spreads so their resources in cattle will be conserved.

Hides and Skins.

Instruction in the preparation of hides has been systematically undertaken with great success at one important centre in the Kavirondo reserve by a stock inspector who was given a course of instruction under the auspices of the United Tanners' Federation. In other respects the position in regard to marketing and so forth remains much the same as indicated in my last report.

The quantity of hides exported fell from 62,063 cwts. in 1925 to 51,631 cwts. in 1926, and similarly the value dropped from £260,866 to £180,423. In the case of sheep and goat skins, however, the quantity rose from from 825,424 to 990,185 and value from £54,605 to £55,480.

Ghee.

Chiefly from funds provided by the Local Native Councils a considerable number of centres have been established for the manufacture of ghee. The work requires supervision and direction by an officer skilled in dairying, in order to improve and maintain the quality of the output and to check the payment made to suppliers. The marketing of the product also requires attention in the interests of the producer. For these reasons provision was sought and obtained for the services of an officer to supervise ghee production.

On European farms the production of ghee rose from 108,153 lbs. in 1924-25 to 115,815 lbs. in 1925-26.

The estimated value of agricultural exports of native origin for the last five years are shown hereunder :

	1922	1923	1924	1925	1926
	£	£	£	£	£
Animals	1,200	10,000	20,000	16,800	11,000
Copra & Coconuts	12,000	10,280	35,000	28,000	20,600
Cotton	—	—	11,860	41,000	32,750
Groundnuts ..	20,000	24,000	26,000	19,000	31,000
Maize	73,000	120,000	130,000	100,000	70,000
Millets	1,000	4,000	300	865	2,750
Pulse	7,000	12,000	15,000	16,000	20,400
Simsim	4,800	22,000	84,000	65,000	76,500
Hides	45,000	60,000	121,000	210,000	140,000
Skins	5,000	3,000	30,000	50,000	51,000
Oil—Simsim ..	—	2,400	2,200	3,000	5,500
Potatoes	5,000	3,000	4,000	4,000	7,250
Miscellaneous ..	1,000	1,000	1,000	1,000	2,000
TOTAL .. £	176,000	271,680	480,360	564,665	470,750

The reduction is due chiefly to shortfall in the export of maize and hides It should be noted also that the value of native agricultural produce sold for local consumption amounts to a large figure.

Live-stock Industry.

Reference has been made to native-owned live-stock under the head " Native Agriculture."

The following table shows the numbers of live-stock owned by Europeans during the last five years :—

	1922	1923	1924	1925	1926
Cattle—Total ..	172,397	190,140	211,381	216,589	213,423
(*a*) Breeding stock	97,260	104,631	110,855	110,547	105,556
(*b*) Oxen ..	74,137	85,509	100,526	106,042	107,867
Horses	1,351	1,454	1,642	1,846	1,844
Mules	1,237	1,093	985	922	780
Donkeys	1,512	1,260	1,213	1,336	931
Sheep (wool-bearing)	109,748	112,046	133,916	140,725	162,848
Sheep (native) ..	24,137	35,014	32,132	38,071	43,057
Goats	5,130	6,258	4,618	5,372	4,454
Pigs	16,121	12,120	10,608	8,564	9,125
Poultry	34,371	38,685	38,910	31,150	39,728

It is shown that there was a decrease of 1.46 per cent. in the total number of cattle for 1926. There was actually a slight increase—1925 head—in the number of oxen (trained and untrained), but in breeding stock there was a drop of 4,991 head. Reference was made in previous reports to the unsatisfactory position of the cattle industry. It is disappointing that, after many years of well-sustained effort on the part of stock-owners, assisted by protective measures efficiently rendered by the Veterinary Department, at considerable cost, the industry has not made greater progress.

The increase in wool-bearing sheep is noteworthy and amounts to 15.72 per cent. The export of wool increased from 4,948 cwts. in 1925 to 7,454 cwts. in 1926 and in value from £37,776 to £62,450.

There is a small increase in pigs and a substantial increase in poultry.

The following table gives the production and sale by Europeans of certain animal products, excluding meat, etc., during the last few years :—

Year	Milk	Cream	Butter	Cheese	Ghee	Bacon and Hams	Wool
	Galls.	Galls.	lbs.	lbs.	lbs.	lbs.	lbs.
1925–26	395,031	72,693	291,894	144,070	115,815	430,119	670,752
1924–25	371,692	85,557	303,085	92,994	108,153	364,552	461,588
1923–24	372,103	107,669	252,990	93,248	112,815	—	427,266
1922–23	351,920	43,352	246,544	145,452	97,439	—	445,024
1921–22	242,234	36,985	236,703	65,520	16,287	343,045	330,781

Among dairy products the position in respect of production fluctuates. During the last year there was an increase in the sale of fresh milk, decreases in cream and butter, and increases in cheese and ghee. Taking the ratio of :—

2.25 gallons milk to 1lb. butter
1.1 ,, ,, ,, ,, cheese
2.6 ,, ,, ,, ,, ghee
3.2 lbs. butter per 1 gallon cream

it is calculated that the production of the primary product—milk—has increased from 1,000,189 gallons in 1921-22 to 1,729,470 gallons in 1925-26.

Importations.

The importations of pure-bred cattle for the last three years are as follows :—

	1924	1925	1926
Shorthorn Bulls	11	24	26
,, Cows and Heifers	13	13	—
Friesland Bulls	2	49	4
,, Cows and Heifers	—	36	4
Ayrshire Bulls	2	16	9
,, Cows and Heifers	—	—	1
Hereford Bulls	—	6	—
Aberdeen Angus Bulls	2	2	1
Africander Bulls	—	2	—
Jersey Bulls	2	8	2
,, Cows and Heifers	—	—	6
Kerry Bulls	—	1	—
,, Cows and Heifers	—	3	—
Red Poll Bulls	—	3	3
,, Cows and Heifers	—	1	—
Swiss Bulls	2	—	—
TOTALS	34	164	52
Total Bulls	21	111	45
Total Cows and Heifers	13	53	7

The fall in importations of pure bred cattle as between 1925 and 1926 is very considerable and it is unfortunate that a larger number of pure-bred females are not introduced.

Veterinary Department.

ADMINISTRATIVE AND EXECUTIVE DIVISION.

The total expenditure for the year was £38,627, an increase of £2,186 over 1925. The revenue was £25,639, an increase of £1,119 over the previous year. As explained in the report of the Honourable the Chief Veterinary Officer the revenue includes laboratory products manufactured by the Research Division and used by the field staff in the work of disease control.

The maintenance of the rate of inoculations against disease as reflected in the revenue figures is an indication of the establishment of the work on a permanent basis.

As shown in the report for the Division, the Colony, like the rest of East Africa, is peculiarly situated in respect of the major diseases causing economic loss and the natural immunities to widespread enzootics like rinderpest, pleuro-pneumonia and East Coast Fever backed up by artificial immunities conferred by the veterinary staff, make information like the foregoing of more importance in annual reports than detailed reports of individual outbreaks.

Rinderpest.

The following table gives the figures of rinderpest inoculations. The numbers of cattle dealt with are a satisfactory indication of the permanency of the work.

The conditions under which the work is carried out compare unfavourably with other countries. As these improve it is hoped that the mortality figures will be reduced.

RINDERPEST DOUBLE INOCULATIONS, 1926.

	Double Inoculations	Virulent Blood Tests	Serum Alone	Mortality
In settled areas ..	12,607	—	2,077	456
Rinderpest Service in settled areas	60,301	1,949	—	382
Veterinary Quarantine Stations	88,042	17,442	6,033	2,911
Native areas Rinderpest Service	33,356	—	—	438
TOTALS ..	194,306	19,391	8,110	4,187

Pleuro-Pneumonia.

The year under review was particularly free from incident in connection with this disease. Stockowners continued to avail themselves of the vaccine which is issued gratis by the

Government, but it is to be regretted that the number of doses asked for shows a big reduction as compared with the quantity used by stockowners in 1925. Approximately 20,000 doses less being applied for during 1926.

East Coast Fever.

The report of the Chief Veterinary Officer contains a reasoned and valuable statement of the position in the Colony with regard to East Coast Fever, and it clearly establishes the complications of the position. The subject is one that calls for serious consideration and further research, to which attention is being given.

As compared with the Union of South Africa and Southern Rhodesia, where attempts have for many years been made to eradicate the disease, the conditions obtaining in this Colony render the efforts of stockowners and the Veterinary Department to prevent serious losses in the alienated areas and the spread of the disease into areas hitherto regarded as " clean " much more difficult.

Here in Kenya the enzootic character of the disease over extensive areas both in the native reserves and in settled areas, the almost entire absence of fencing, and the paucity of dipping tanks, together with the surreptitious movement of native-owned stock, makes the task of the Veterinary Department in protecting stockowners' interests one of extreme difficulty, and all combine to inhibit the progress of the cattle industry.

Other Diseases.

Anthrax, blackquarter and diseases of calves continue to cause mortality. It is satisfactory to note the decrease in outbreaks of the first two diseases mentioned and the increased demands for protective vaccine. Calf mortality will lessen as management improves, especially with regard to nutrition.

Veterinary Stations in the Reserves.

The results of the work at the stations in the native reserves where native owners bring their cattle for inoculation continue to be encouraging.

The establishment of the Central Veterinary Training Depot was delayed but preliminary work on fencing, etc., was carried out.

Fees for Veterinary Services.

These were revised both for field services and for the supply of sera and vaccines and adjustments made in the light of use and costs of production without appreciably affecting revenue.

Slaughter Stock.

The returns for the past four years are given as of interest.

	1923		1924		1925		1926	
	Nairobi.	Mombasa.	Nairobi.	Mombasa.	Nairobi.	Mombasa.	Nairobi.	Mombasa.
Cattle ..	8,933	2,962	11,085	4,061	13,331	5,337	10,427	4,491
Sheep and Goats ..	19,893	7,816	20,212	3,360	19,248	18,598	20,901	19,457
Pigs ..	1,366	—	945	—	672	—	784	—

The returns of cattle for 1925 were abnormally high as on account of the shortage of meat small and lean cattle were slaughtered, as explained in my last report. There is a considerable and growing consumption of meat on estates and in native reserves for which no records are available. With an improved and regular supply of beef cattle, and some reduction in price, opportunities would be afforded for supplying a good and increasing market in Uganda and with the advancing prosperity of the Africans, together with increased demand created by the inclusion of meat in the rations of native workers, the demand for beef is likely to increase.

Brands Ordinance.

230 brands were registered, an increase of 55 over the previous year. 11 were transferred, and 118 cancelled.

The demands for squatter brands increased during the year, and 131 were registered.

The brands directory was brought up to date.

DIVISION OF VETERINARY RESEARCH.

Technical Routine.

(*a*) *Preparation of Laboratory Products* :—

The amount of serum, vaccines, etc., issued during 1926 was :—

Anti Rinderpest serum : 14,241,050 ccs.
Others : 887,697 doses.

(*b*) *Routine diagnosis* :—

This included the examination of smears, specimens, etc., forwarded for examination which totalled, for the year, 18,335.

Technical Research.

(A) DISEASES OF CATTLE.

1. Rinderpest.

(*a*) *Preparation of a vaccine.*

The introduction of a vaccine for the immunisation of cattle against rinderpest is under consideration, and the

necessary plant for the purpose of proceeding with this research is being installed, and when complete, the investigations will be commenced.

(*b*) *Elimination of redwater-gallsickness infections from rinderpest virus.*

In view of the risks involved in inoculating rinderpest blood obtained from cattle recovered from redwater-gallsickness, to cattle born and reared on farms on which dipping has been carried out from, or shortly after birth, experiments were commenced to determine :—

(1) Whether the injection of the virus-maker with trypanblue at the commencement of the temperature reaction will be of assistance in overcoming the risk of transmitting redwater.

(2) Whether it is possible to eliminate redwater-gallsickness by altering the physical properties of the blood, or by other means.

Research conducted by the Assistant Chief Veterinary Research Officer (Mr. R. Daubney) with the object of obtaining rinderpest virus from blood and free from blood cells, by various filtration methods, gave negative results.

(*c*) *To ascertain what factors influence the serum output of an animal.*

Captain R. L. Creery, Veterinary Officer, made the following observations :—

(1) That blood obtained from the first bleeding after hyperimmunisation, generally speaking, produces less serum ;

(2) That the output of serum was increased when the cattle were being fed liberally with green food ;

(3) No marked difference was noted in the output of serum from grades or native cattle ;

(4) One of the best serum producers was a native animal.

2. East Coast Fever.

Research on East Coast Fever immunisation has been continued with a view to :—

(1) Reducing the losses from natural infection ;

(2) Conferring immunity to cattle destined for transport work, and for use on infected farms.

The most satisfactory results were obtained with cattle of from, approximately, two years to four years, and which had recovered from redwater and gallsickness, or which had been artificailly immunised against both these.

It was found :—

(1) That whereas injection of spleen pulp of an infected East Coast Fever beast which had recovered from redwater and gallsickness did not necessarily transmit redwater, provided redwater parasites were not visible microscopically in the spleen pulp, the injection of spleen pulp showing redwater parasites invariably produces redwater into susceptible cattle, and sometimes a reaction in cattle previously recovered from redwater.

(2) Anaplasmosis was usually transmitted to susceptible beasts, the reaction commencing about the thirtieth day after inoculation, consequently, if cattle are exposed on or about the thirtieth day after inoculation to East Coast Fever tick infection, the anaplasmosis reaction may be complicated with the East Coast Fever exposure reaction or *vice versa*.

Inoculated cattle, which are susceptible to, but escape redwater when inoculated with spleen pulp, contract redwater about the third week after exposure to natural infection, and hence there is a possibility of the East Coast Fever exposure reaction being complicated with the redwater reaction or *vice versa*.

It is essential, therefore, that cattle submitted for East Coast Fever immunisation should have previously recovered from natural infection from redwater and gallsickness, or from artificial immunisation.

Results obtained with unweaned and recently weaned calves were not very satisfactory. Further experiments are now in progress to compare the value of the following methods of immunising—

(*a*) newly born unweaned calves;

(*b*) newly born hand-reared calves, viz. :—

(1) Infesting immediately after birth with a few infected nymphae or adult ticks;

(2) Inoculation in the jugular shortly after birth with redwater-gallsickness vaccine, and intra-jugular injection of spleen pulp of an infected East Coast Fever beast susceptible to redwater and gallsickness, and fourteen days later infesting them with infected nymphs or adults;

(3) Injection of an emulsion of nymphal or adult ticks which engorged as larva or nymphs on an infected beast, and which, after moulting, are fed for ninety-six hours before emulsifying.

Further researches on the nature of the immunity conferred to East Coast Fever by natural infection or exposure thereto, in inoculated and non-inoculated cattle, may be summarised as follows :—

(1) Of the inoculated cattle :—

12.8 per cent. reacted to the original exposure ;

17.9 per cent. gave an indefinite reaction to the original, and a definite reaction on subsequent exposure or *vice versa ;*

19.2 per cent. reacted to the original but not to subsequent exposure ;

8.9 per cent. did not react to the original but to subsequent exposure ;

20.5 per cent.gave an indefinite reaction to the original or subsequent exposure ;

20.6 per cent. did not react to the original or on subsequent exposure ;

(2) Of the non-inoculated cattle :—

62.5 per cent. reacted to the original but not to subsequent exposure ;

12.5 per cent. reacted to the original and to a subsequent exposure ;

25.0 per cent. gave an indefinite reaction to the original but a definite reaction to subsequent exposure.

Conclusions.

(1) Immunity conferred to East Coast Fever by recovery from natural infection is not always complete in inoculated and non-inoculated cattle.

(2) In some instances, inoculation confers a temporary immunity against natural infection.

(3) The reaction to natural re-infection is usually not severe, and may escape notice in cattle not under close observation, but sometimes a marked reaction and death occurred.

These results are of practical importance in connection with the "T" branding of cattle destined for transport work from infected to clean areas or *vice versa.*

It would be unsafe for cattle which have been inoculated, surviving one exposure in a highly infected camp, to be considered as "T" branded cattle for transport purposes between infected and clean areas, and *vice versa.*

The advisability of branding such cattle with a distinctive brand other than " T " brand might perhaps be considered.

Experimental field inoculation for the immunisation of cattle against East Coast Fever was carried out on Mr. J. Stanning's farm, " Inglewood," Lumbwa.

Certain data regarding reactions to inoculations and exposure to infection were obtained, and corresponded with, in some measure, results obtained at the Laboratory. This inoculation was carried out on a herd already infected, and no doubt some of the inoculated animals had, previous to inoculation, recovered from natural infection.

The number of cattle inoculated was 147 head and twenty-nine days after inoculation the mortality from East Coast Fever had ceased, 33 animals having died in the interval. The remaining animals were exposed to infection during the remainder of the year, during which time no deaths from East Coast Fever occurred. The indications are that immunisation is of assistance in combating an outbreak of East Coast Fever.

(3) Bovine Lymphangitis.

Research was conducted by the Assistant Chief Veterinary Research Officer (Mr. R. Daubney) which resulted in the isolation of an organism considered to be the casual organism of the disease.

(4) Mortality in Calves.

The Assistant Chief Veterinary Research Officer (Mr. R. Daubney) conducting researches on mortality in calves, reports the existence of the following organisms as responsible for mortality in individual cases :—

(1) *Bacillus paratyphosus* ;

(2) *Bacillus coli* ;

(3) *Bacillus proteus* ;

(4) *Bacillus pyocyaneous* ;

(5) Delayed lactose-fermenters of the *Bacillus coli* group, with paratyphoid as the casual organism in the majority of cases.

Experimental vaccines and bacterins prepared from these organisms, and sera obtained from hyperimmune cattle, have been issued to stockowners.

According to reports of owners, the use of bacterins is quite successful in curtailing outbreaks of the disease on small, lightly infected farms. It failed completely, however, to affect the incidence of infection on the more heavily infected and larger premises.

The inoculation of a living vaccine together with inoculation of a hyperimmune serum was tried, and was successful on some farms; on others its practice was attended with only a moderate degree of success. The use of hyperimmune serum for the treatment of vaccine reactions and natural infections was also tried.

(5) Streptothricosis (or Uasin Gishu Skin Disease).

The Assistant Chief Veterinary Research Officer (Mr. R. Daubney) reports as follows :—

Several strains of the causal organism of this disease have been isolated, both from cattle and sheep, but attempts to reproduce the disease in cattle by the application of pure cultures to the skin, after scarification, have so far failed. Observations as regards treatment of the condition are being made.

(6) Diseases of Sheep.

Research into the lung disease of lambs and sheep, as seen more particularly in the Laikipia district, has been continued, and observations as to the pathogenicity or otherwise of an organism isolated from the affected lungs of lambs has been made, with the result that it has been found to be pathogenic, but in only two instances have typical lung lesions been produced in experimental cases.

In all cases on inoculation into healthy lambs the organism has produced a purulent arthritis with fatal results in some cases.

Experimental vaccines made from culture of this organism have been issued to stockowners for experimental use in flocks.

During the year 31,043 doses of these experimental products have been issued, in which are included the following types of vaccine :—

Vaccine No. 1.—Dilute suspension of the killed organism in saline solution;

Vaccine No. 2.—Heavy suspension of the killed organism in saline solution;

Vaccine No. 3.—Filtrate of a broth culture of the organism;

Vaccine No. 4.—Killed broth culture of the organism.

In some instances the vaccine does not appear to have been of value, but in others, owners have given it as their opinions that the the vaccine prevented infection and mortality in inoculated lambs.

The incidence of the disease as an epidemic amongst flocks in the Laikipia district does not appear to have been so great during the latter part of 1926 as previously.

(7) Parasitic Worms.

Mr. R. Daubney, Assistant Chief Veterinary Research Officer, reports as follows :—

Three new species belonging to the round-worms sub-family *Trichostrongylidae* have been collected.

Three species of worms have been mainly concerned in the causation of losses in sheep during the year.

These are, in the approximate order of importance, the hookworm, the wireworm and small Trichostrongyles.

Investigations are in progress with reference to various points in the life-history of the hookworm species, and on treatment of infested animals by therapeutic measures.

No efficient anthelmintic has, as yet, been found for the treatment of infestation with small trichostrongyles. The flock-owner is therefore entirely dependent upon success of general measures to prevent heavy infestation with these species.

(8) Diseases of Swine.

East African Swine Fever.

Attempts to obtain an attenuated virus with a view to conferring immunity against natural infection, and immunising domestic pigs destined for anti-serum production, were continued.

The results obtained show :—

(1) That blood collected during the reaction from a domestic pig which reacted and recovered to the injection of blood of a naturally infected pig after passage, produces inconstant results, as regards reactions and mortality, in susceptible pigs;

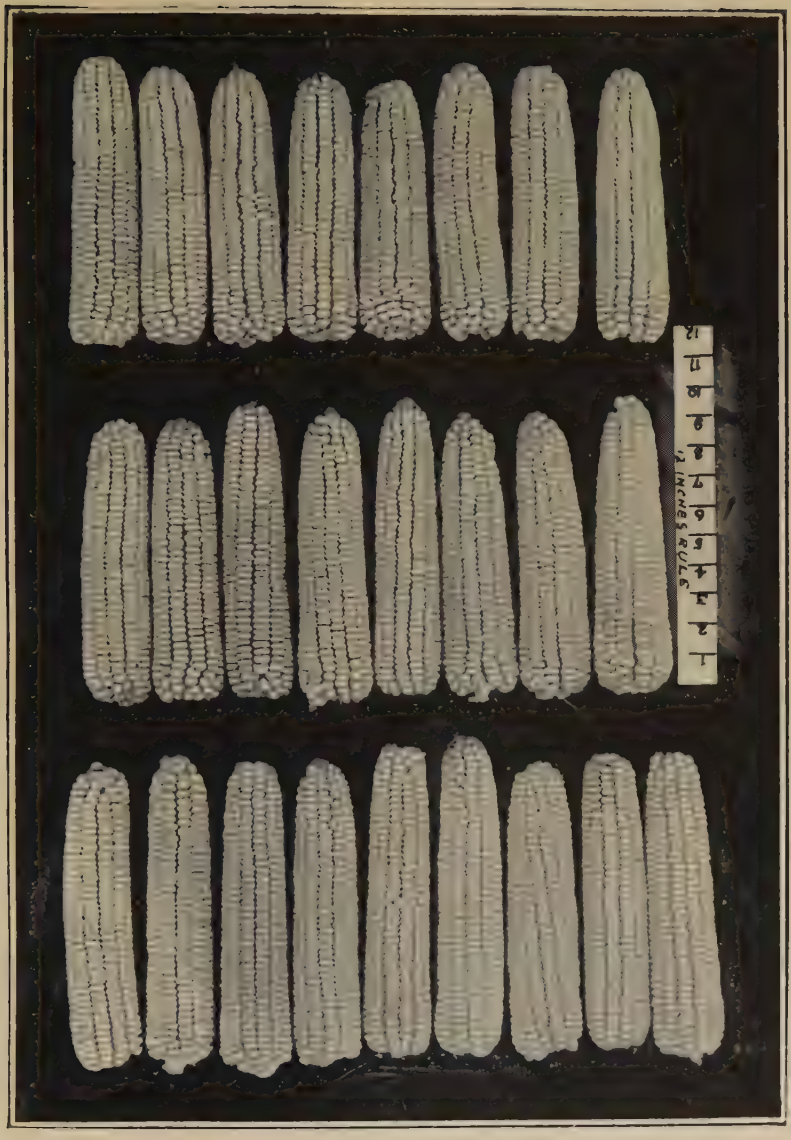
(2) Pigs which reacted and recovered, when subsequently tested on their immunity with blood of another pig which reacted to the same strain of virus, or which were put in contact with pigs reacting to the same strain of virus, again reacted and died of swine fever.

(3) Pigs which reacted and recovered, and again reacted and recovered to re-inoculation with the same strain of virus after passage, again reacted and died when re-inoculated with virus of the same strain, or when put in contact with a pig reacting to the same strain of virus;

The value of the following method of preparing an anti-serum in now being investigated, viz. :—

(*a*) Inoculation of susceptible pigs with an attenuated virus, to be obtained if possible by inoculation of a

PLATE 2.



Selection of Cobs of Kenya "Flat White" as above

naturally recovered pig with virulent blood, and collection of its blood when reacting, or by collecting blood from a susceptible pig which reacts and recovers to inoculation;

(*b*) Re-inoculating the survivors with gradual increased doses of virus;

(*c*) Collection of serum from the pigs which survive inoculation with increasing doses, and

(*d*) Simultaneous injection of the serum and the strain of virus used to produce the serum, followed some days later by simultaneous injection of the serum and a more virulent virus;

(*e*) Inoculation of the survivors with increasing doses of the more virulent virus.

The Chief Veterinary Research Officer was absent on leave during the latter part of the year, during which period the Assistant Chief Veterinary Research Officer (Mr. Daubney) acted for him.

While on leave Mr. Walker visited Onderstepoort Laboratory, South Africa, on many occasions, and had an opportunity of discussing various stock diseases problems with Sir Arnold Theiler, and of becoming acquainted with the current research work being carried out at the institute.

Visits were also paid to Bechuanaland and Northern Rhodesia, and during these visits Mr. Walker took the occasion of discussing with the chief veterinary officer of each territory various matters, particularly bovine pleuro-pneumonia.

AGRICULTURAL CHEMISTRY.

For the greater part of the year the staff was at full strength. Mr. Pickering, the laboratory assistant, proceeded on home leave at the end of October.

About 1,000 letters were dealt with and 597 reports were issued.

In connection with experimental work and soil study 2,760 miles of car travelling were performed. An exhibit was staged at the Nakuru Show and a lecture delivered to the Coffee Planters' Union. Papers were also read before the East African Agricultural Conference by Mr. Beckley and Mr. Fox.

The analytical work performed in the laboratories has increased appreciably; 887 samples were examined in the laboratory in connection with routine and investigational work. Of these 569 were dip samples while most of the remainder were investigational samples.

There has been a slight improvement in the standard of the maintenance of the strength of dip washes, but the general condition remains very far from satisfactory.

The cause of the fermentation of coffee has been the subject of investigation. The results of the investigation have been most interesting, showing that the fermentation is due to a ferment in the coffee itself. It is probable that a standardised fermentation may be evolved.

A large number of "green manure" plants have been tried. The most promising for coffee are *crotalaria incana* and *intermedia* and varieties of lupin; for cereals, the most promising are *dolichos lablab (njahi)*, *phaseolus inamonenus*, some varieties of cowpea, lupins and field peas.

Manurial experiments have been conducted at the Scott Laboratories, in the Kyambu area, and in the Nakuru area.

Weather conditions were unfavourable from the point of view of these experiments and to some extent vitiated the results, and the lateness of the season delayed reaping till early in 1927. However, the results obtained during the year do show that the use of phosphates has been attended with beneficial results. Other manures have not been successful and were monetary failures.

ENTOMOLOGY.

No changes occurred in the staff of the Entomological Division.

In all 6,252 miles were travelled by car on Government service, and 1,167 letters were dealt with.

Some 250 specimens were examined and reported upon. 235 permits for the importation of plants or seeds were dealt with. Packages of plants entering the country were examined and certificates issued for the export of plants and coffee to neighbouring territories.

Exhibits were staged at the Nakuru Show and many additions were made to the entomological collections.

The following publications were issued :—

"The Coffee Mealie-bug; Recommendations for Control Measures." T. W. Kirkpatrick. Local Press.

"Insect Pests of the Maize Crop." T. J. Anderson. Bulletin No. 5, Department of Agriculture.

and papers were read at the Agricultural Conference.

Coffee.

Experiments have been continued throughout the year by Mr. Kirkpatrick in banding with repellents or other substances to prevent the ants gaining access to the mealie bug infested trees, with the object of obtaining the most efficient and, at the same time, cheapest method. It has been proved conclusively that, if the ants are kept off, the natural parasites are efficient in controlling the scale. In spite of the short time this work has been in progress, reasonably satisfactory

results have been obtained, but it cannot be expected that anything like a final solution can be reached for some considerable time.

A new berry-borer (*Eucoama*), a tip-borer (*Terastia*) and a leaf-eating caterpillar (*Odites*) have been recorded for the first time.

Maize.

The stalk-borer has been responsible for considerable damage. A considerable amount of work has been done in investigating this pest, and the times of planting, destruction of volunteer maize, rotation of crops, destruction of crop remnants are being studied with relation to the control of the borer.

Cotton.

The pink boll-worm now appears to be established on the coast but is, to a great extent, controlled by a Braconid parasite.

Recommendations are made which it is thought will, if effectively carried out, greatly reduce the incidence of this and other pests of cotton.

MYCOLOGY.

The Mycologist proceeded on leave on the 22nd September and Mr. Wilkinson took over his duties as from the 20th September, 1926.

During the year the Mycologist was absent from Headquarters on duty for thirty-two days, during which time some 93 estates were visited and 2,850 miles were travelled.

Further surveys were made for the distribution of sugar cane mosaic and so far as is known this disease is still confined to sugar in the Nyanza Province. No signs of mosaic have been found on native grasses. With a view to the complete eradication of the disease, the growth of any but Uba cane has been prohibited for a period of two years in the area affected. Mr. C. G. Hansford, M.A., rendered valuable assistance in the investigation of mosaic disease in the Nyanza Province during his passage through this Colony to take up his appointment as Mycologist in Uganda.

Streak disease of Uba cane and glume-blotch of wheat caused by *Septoria nodorum* (Berk), have been reported for the first time in Kenya.

Attacks of a species of fusarium on maize and glume-blotch on wheat were reported in certain districts as causing damage. It is thought that the unusual weather conditions experienced were mainly responsible for these outbreaks.

Rhizoctonia solani Kuehn is considered definitely to be the cause of coffee seedling disease but much needs to be done to determine the precise conditions favouring infection.

Enquiries dealt with regarding plant diseases covered a range of twenty-two different hosts. Several diseases are recorded for the first time in the Colony.

A considerable number of specimens have been authentically named by the authorities at Kew and these have now been added to the herbarium.

PLANT-BREEDING.

The Plant-Breeder returned from leave in July. During his absence the work was carried on by Mr. E. Harrison, Deputy Director of Agriculture, and Mr. R. N. Noble, Junior Clerk.

Sir Rowland Biffen, the eminent English wheat-breeder, was invited by Government to visit the Colony and report and advise on the wheat industry and the methods adopted to improve it, particularly in the matter of raising suitable rust-resistant varieties of wheat. He visited all the more important wheat-growing areas of the country in November. A portion of his valuable report has already been received and published. It is a matter for some gratification that he reports very favourably in respect of the work hitherto done by this Department and hopefully in regard to the prospects of the industry. It is likely as a consequence that further funds will be available for the important work of plant-breeding, resulting in an increase of staff and the institution of a central plant-breeding station at Njoro, with sub-stations at Mau Summit and the Scott Agricultural Laboratories.

Informal addresses on wheat were given by the Plant-Breeder at Upper Gilgil, Londiani, Eldoret and Kitale, and a number of farms were visited for the purpose of inspecting wheat crops.

The work of raising new rust-resistant varieties through hybridisation was continued at the Scott Agricultural Laboratories and at Natai Emuin Farm, Njoro. At the Scott Agricultural Laboratories some seventy families of wheat appeared to be pure for immunity or high resistance to black stem rust, and other families were still in a hybrid condition as regards both rust-resistance and other qualities. At Njoro some fifty families of wheat appeared to be immune or highly resistant both to black stem rust and yellow rust. Other families were resistant to one or other of the rusts. At Upper Gilgil a number of varieties were tested for resistance to yellow rust and were at the same time multiplied preparatory to issue. A few varieties were experimented with at Londiani; in the Trans Nzoia a variety which may prove of great value to that district was found by Mr. Harrison amongst a crop of Cross XI.

It would seem that results are beginning to appear as a consequence of the wheat breeding work initiated six years ago. There are a number of hybrid wheats now in a pure condition

and in fair quantity (*i.e.* a few ounces) which show signs of immunity or high resistance to rust. Too much optimism must not however be displayed yet as, under field conditions, some varieties may prove susceptible to rust and other varieties, though immune to rust, may not be entirely suitable in other ways for agricultural purposes. It is hoped, however, that a small proportion of the new wheats may be sufficiently high yielding to be of economic value. The first stage in the production of rust-resistant wheats has been accomplished, the second stage is to tack the quality of high yield on to the quality of rust-resistance.

The past year has on the whole been a poor one for wheat. Rust has been very destructive in the Njoro area, and at the higher altitudes the yields of wheat have been seriously diminished by the attacks of a *Macrophoma* fungus which has been caused by the continued cold and wet conditions prevalent during the year. Nevertheless the acreage sown with wheat is steadily increasing.

Kenya Governor wheat has proved very successful and the issue of this variety by the Department has greatly assisted wheat growers. It is unfortunate that a large quantity of this wheat was sold to the mills during the latter half of this year; this is to be attributed to the lack of storage and the fear of attack by weevils during the period between the Machakos harvest time (August) and the sowing period (June and July) of other parts of the country. It is hoped that there will be sufficient seed of Kenya Governor available for all requirements in 1926.

The experience of the year under review has shown that phosphatic manures have been beneficial to the wheat crop, particularly on the lighter and thinner soils.

PLANTATION INSPECTION.

During the month of September thirteen estates in the Ngong district were inspected. It was found that the coffee in this district was remarkably free from fungous diseases and insect pests. The trees showed to a marked degree a thick matted growth similar to that observed in the Songhor and Upper Limoru districts. This condition is thought to be a result of unfavourable climatic conditions such as cold winds and heavy dews, or rain, followed by sunshine.

It was very noticeable that coffee trees growing on the multiple stem system showed this " matting " of the leaf surface to a small degree.

During October eight estates in the Mua Hills were inspected and separate reports have been submitted.

From the 6th to the 11th October inspections were made of the sugar at Messrs. Nottidge and Allen's, Muhoroni, and also of that belonging to the Miwani Sugar Company, for mosaic. Separate reports have been submitted under the signature of Acting Mycologist.

Apart from these inspections, only single estates have been visited according as the situation demanded and as time could be spared from other duties; in all about eight estates.

GRADER AND INSPECTOR.

Staff Changes.—Mr. F. B. L. Butler proceeded on leave on 17th May and had not returned at the end of the year. Mr. B. F. Ratcliffe returned from leave to the appointment of Assistant Grader and Inspector on 21st June. Mr. Riddell, clerk, was transferred to Nairobi on 6th March. Mr. Myers clerk, was transferred to this office from Nairobi on the 28th February, and proceeded on leave on 30th October, being relieved by Mr. S. G. Sharp. On November 17th, owing to the absence from duty of Mr. Butler and Mr. Ratcliffe, Mr. H. J. Taylor, Agricultural Supervisor, assisted with the grading until the end of the year.

Plant Import Inspection.—3,441 packages of the value of Sh. 178,562/35 were passed for importation into the Colony. 138 packages were passed in transit to Uganda.

Maize Grading and Conditioning Services.—542,852 bags were graded during the year. 120,000 or 24 per cent. of this was native grown.

68,000 bags were shipped under No. 25 of the Maize Grading Rules. 49,336 bags were rejected as wet.

Maize was shipped in bulk for the first time since the Grading Rules came into force, 69,000 bags being shipped in this manner.

The weighing of 10 per cent. of the bags on arrival here was continued by the Kenya and Uganda Railway. 25,710 bags were rejected as underweight.

Maize Conditioning Plant.—105,976 bags of maize were conditioned during the year, 70,000 of these during the period September to December. A period of congestion occurred between the 14th October and 9th December. To meet this the running hours were increased to 120 per week. 1,252 bags were consigned direct to the plant, and treated at the reduced rate of 50 cents. per bag.

Export of Beans.—Certificates were issued for 4,472 bags.

Export of Potatoes.—95 certificates of freedom from wart disease, covering 15,700 packages of potatoes, were issued.

The revenue derived from grading, conditioning and inspection amounted to £5,046 during the year.

ECONOMIC SURVEYS.

Investigations were completed and a report made upon the area to be served by the projected branch railway line in Kavirondo.

It is desired to urge the importance of making an economic survey as near as possible to the date upon which a definite decision has to be made with regard to the construction of a line, otherwise the reports are apt to get out of date and inapplicable in certain respects due to changing conditions.

LABOUR.

The following comparative table of the average number of units of native labour employed monthly on European farms shows an increase of 6,084 labourers (men, women and children) for the year ended June, 1926.

Year	Men	Women	Children	Total
1919–20	45,005	3,917	4,787	53,709
1920–21	55,939	4,911	6,539	67,388
1921–22	61,753	4,261	5,935	61,649
1922-23	54,406	6,609	9,942	70,957
1923–24	66,993	8,316	11,784	87,093
1924–25	61,735	8,477	11,315	78,527
1925–26	64,875	6,021	13,717	84,611

There was a substantial increase in the average number of labourers employed monthly, amounting to 6,084, or 7.75 per cent. over the previous year. The number did not reach the figure of 1923-24, but it is thought that with economies effected in the use of labour-saving machinery and appliances, and the better organisation and management of labour, the position in 1925-26 was on the whole satisfactory. In support of that there is the evidence of advance in development and production achieved in the absence of a comparable increase in the number of units of labour employed.

AGRICULTURAL SHOWS.

In addition to the Native Agricultural Shows to which reference has already been made, two successful Shows were held at Nakuru (in January and December) under the auspices of the Agricultural and Horticultural Society. The last Show suffered from the paucity of cattle exhibits due to outbreaks of disease, but the quality of the produce and in particular the representative character of the district exhibits was well sustained. The interest taken in horse-breeding, chiefly for sport and pleasure purposes, is reflected in the great improvement shown in the quality of the horses bred in the Colony. At each of these Shows an exhibit representative of the Department's activities was staged. The grant-in-aid of £500 was paid by Government to the Society mentioned above, and it is gratifying to note that with public support and through its successful Shows its financial position is steadily improving.

EAST AFRICAN STUD BOOK.

Volume III. was published during the year.

The Stud Book account is in a satisfactory position, there being a credit balance of nearly £200 as at December 31st, 1926.

LAND SETTLEMENT.

The number of European holdings under occupation increased from 1,625 in 1925 to 1,809 in 1926, or an increase of 6.7 per cent.

In connection with the compilation of the Agricultural Census for the year 1926, an endeavour was made for the first time to ascertain the total number of Europeans engaged on agricultural undertakings.

From the returns received it would appear that (including occupiers and/or their managers) there are 2,324 Europeans regularly engaged in agricultural pursuits.

An analysis of the non-native population census taken by Government in April, 1926, gives the figures of 2,199 as being engaged in agricultural activities. The difference is most likely due to men working in the dual capacity of agent, storekeeper and farmer.

The opportunities for an advance of settlement are very favourable in many directions, but it would appear that its rate of progress has been deterred through the apprehension which existed in regard to labour supply. With an improvement in the labour situation greater confidence should now be placed in the resources of the Colony to absorb and provide for a considerable number of new settlers annually.

Another factor which tends to restrict the progress of settlement is the large amount of capital required to acquire land and finance an agricultural holding.

SOUTH AND EAST AFRICAN AGRICULTURAL CONFERENCE.

The first South and East African Agricultural Conference assembled in Nairobi during August. The Conference was attended not only by delegates from the British South and East African Territories, but by delegates from Portuguese East Africa, Mozambique, Belgian Congo and Italian Somaliland, making it representative of the whole of Africa bordering upon the Indian Ocean.

The agenda presented was too great for the Conference as a whole to discuss all the items. Accordingly the Conference divided into three sections: (1) Agriculture, (2) Cotton, (3) Entomology and Mycology. Before each section were read papers upon subjects of special interest to the members of that section, and subjects that concerned two or more sections were discussed before joint meetings of those sections. In all some

eighty subjects which otherwise could not adequately have been considered, were discussed by the Conference. The secretarial duties were undertaken by the East African Conference Secretariat.

In order to illustrate points raised by Kenya delegates and to demonstrate the varied conditions encountered in Kenya, the Nakuru, Limuru, Kyambu and Thika districts were visited. The Veterinary Research and Scott Agricultural Laboratories were also inspected.

The ultimate object of the Conference was to secure co-operation between the various agricultural departments in South and East Africa. That the Conference has gone a long way to securing this is certain. The discussions allowed of the promulgation of views and observations which would otherwise not have been available to individual workers.

The fact that the technical officers of the various departments have become personally acquainted should facilitate the interchange of opinions and information, and it was generally agreed that each representative returned to his Administration a better-informed and therefore more efficient officer as the result of opportunities afforded by the Conference.

The success achieved was a source of gratification to this Department, which had been responsible for initiating the Conference and was closely associated with its organisation.

LIBRARY AND PUBLICATIONS.

The following reports, bulletins, etc., prepared by the officers of the Department have been published during the year.

Annual Report of the Department of Agriculture for 1925.

Seventh Agricultural Census Report for the year ended 30th June, 1926.

Meteorological Records for 1925.

Report of Proceedings of the Fourth Maize Conference, 1926.

Grading of Maize Rules, 1925, and Maize Conditioning Plant, Kilindini.

Government Cool Stores, Kilindini; Regulations and Schedule of Charges, 1926.

Rules under the Cotton Ordinance, 1923.

Insect Pests of the Maize Crop, by T. J. Anderson, M.A., B.Sc., F.Z.S., F.E.S., Entomologist (Bulletin No. 1).

Cultivation of Barley, by E. Harrison, M.S.A. (Ames), B.Sc. (Edin.), N.D.A. (Hons.), Deputy Director of Agriculture (Bulletin No 6).

Maize in Kenya, by E. Harrison, M.S.A. (Ames), etc., Deputy Director of Agriculture (Bulletin No. 7).

A Practical Coffee Pulping Station, by A. D. le Poer Trench, O.A.C. (Dip.Ag.), Senior Coffee Officer.

Wheat Growing in Kenya, an address by Sir Rowland Biffen, F.R.S. (*East African Farm and Home Journal* reprint.)

Practical hints on seed treatment against smuts in wheat, barley and oats, by H. Wilkinson, A.R.C.S., F.L.S., F.E.S., Acting Mycologist.

Observations on the nature of immunity conferred to East Coast Fever by natural infection on exposure thereto in inoculated and non-inoculated cattle. (Division of Veterinary Research Bulletin).

DEPARTMENTAL REPORTS.

Submitted with this report are included the following appendices :—

(*a*) Staff Changes and New Appointments in 1926.

(*b*) Staff at December 31st, 1926.

(*c*) Annual Report of the Chief Veterinary Officer.

(*d*) Annual Report of the Chief Veterinary Research Officer.

(*e*) Annual Report of the Agricultural Chemist.

(*f*) Annual Report of the Entomologist.

(*g*) Annual Report of the Mycologist.

(*h*) Annual Report of the Plant Breeder.

(*i*) Annual Report of the Senior Coffee Officer.

(*j*) Annual Report of the Chief Grader and Inspector.

(*k*) Annual Report of the Agricultural Supervisor, Scott Agricultural Laboratories.

(*l*) Annual Report of the Agricultural Supervisor, Coast.

(*m*) Annual Report of the Senior Agricultural Supervisor, Nyanza.

(*n*) Summary of Meteorological Records for 1926.

(*o*) Schedule showing Agricultural Exports for 1926 and previous years.

(*p*) Portion of Annual Report, 1925, omitted in printing.

These reports furnish evidence of the volume and value of the work undertaken by the different sections of the Department, and I desire to conclude this report with an expression of high appreciation of the zeal and devotion to duty shown throughout by members of the staff.

Nairobi,
May, 1927.

ALEX. HOLM,
Director of Agriculture.

APPENDIX A.

Staff.

The principal changes and new appointments during the year under review were :—

Mr. D. L. Blunt, M.A., Senior Agricultural Officer, arrived on first appointment 29th October, 1926.

Mr. L. D. Carpenter, Statistical Officer, retired 16th December, 1926.

Mr. B. H. Frowd, Assistant Agricultural Officer, left the service 18th August, 1926.

Mr. H. J. Taylor, S.E.A.C. (Dip. Hons.), Assistant Agricultural Officer, arrived on first appointment on 6th March, 1926.

Mr. G. M. Hamilton, Flax Officer, left the Service on 31st May, 1926.

Mr. W. G. Leckie, B.Sc., Assistant Agricultural Officer, was appointed locally on 8th May, 1926.

Mr. R. A. Hawkins, Clerk, transferred to the Land Department on 18th April, 1926.

Mr. E. J. Kelly, Clerk, transferred from Secretariat on 1st March, 1926.

Mr. J. Lewison, Clerk, resigned 31st March, 1926.

Mr. R. F. Palmer, Clerk, was appointed locally on 15th March, 1926.

Mr. S. G. Sharp, Clerk, was appointed locally on 24th April, 1926.

Miss J. M. Scotland, Clerk, was appointed locally on 22nd May, 1926, and resigned on 15th September, 1926.

Miss M. M. Burge, Clerk, was appointed locally on 4th October, 1926.

Mr. E. G. Hargreaves, Junior Clerk, transferred to the Police Department on 30th November, 1926.

Mr. D. P. Herne, Junior Clerk, was appointed locally on 1st December, 1926.

Miss E. C. Taylor, Clerical Learner, was appointed locally on 1st January and resigned on 31st December, 1926.

Miss M. E. Hall, Clerical Learner, was appointed locally on 17th March, 1926.

Mr. J. F. Dent, Clerical Learner, was appointed locally on 4th May, 1926.

Mr. B. F. Ratcliffe, Assistant Grader and Inspector, was appointed locally on 1st September, 1926.

2.—Veterinary Administrative and Executive Division.

Mr. H. H. Brassey Edwards, M.R.C.V.S., Acting Deputy Chief Veterinary Officer, was promoted to the substantive rank with effect from 10th September, 1924.

Mr. J. T. C. Bradshaw, M.R.C.V.S., Veterinary Officer, was promoted to Senior Veterinary Officer, with effect from 17th July, 1926.

Mr. M. H. Reid, Senior Veterinary Officer, died on 15th January, 1926.

Mr. G. B. Purvis, Veterinary Officer, left the Service on 8th June, 1926.

Mr. F. R. Hale, M.R.C.V.S., Veterinary Officer, arrived on first appointment on 6th March, 1926.

Mr. J. R. Hudson, M.R.C.V.S., Veterinary Officer, arrived on first appointment on 12th December, 1926.

Mr. G. Scade, M.R.C.V.S., Veterinary Officer, was appointed locally on 9th March, 1926.

Mr. J. H. Ward, Stock Inspector, appointed locally 17th February, 1926.

Mr. A. M. Brauen, Stock Inspector, appointed locally 23rd April, 1926.

Mr. R. W. Forrester, Stock Inspector, appointed locally 1st May and resigned on 30th September, 1926.

Mr. J. J. Dobson, Stock Inspector, appointed locally 1st July and resigned on 10th August, 1926.

Mr. G. B. P. Curry, Stock Inspector, appointed locally -h August, 1926.

Mr. A. H. Moeran, Stock Inspector, appointed locally 19th August, 1926.

Mr. A. E. Wardill, Stock Inspector, appointed locally 1st September, 1926.

Mr. H. C. W. Guy, Stock Inspector, appointed locally 1st October, 1926.

Mr. J. Sim, Stock Inspector, transferred from Veterinary Research Division 18th January and resigned 27th July, 1926.

Mr. A. E. Hudson, Stock Inspector, left the Service on 28th February, 1926.

Mr. H. G. Ulyate, Stock Inspector, resigned 16th February, 1926.

Mr. J. G. Carter, Stock Inspector, resigned 31st August, 1926.

3.—Division of Veterinary Research.

Mr. J. S. McDonald, Laboratory Assistant, transferred Medical Department 8th March, 1926.

Mr. J. Sim, Temporary Farm Overseer, transferred Administrative and Executive Division 18th January, 1926.

Miss N. Judd, Junior Clerk, resigned March, 1926.

Miss R. M. Dennis, Junior Clerk, appointed locally 1st January, 1926.

Mr. E. W. Wildman, Clerk, appointed locally 8th September, 1926.

Mr. F. Lyons, Laboratory Assistant, appointed locally 1st October, 1926.

APPENDIX B.

Staff List of Department of Agriculture.

(As at December 31st, 1926).

Director :

Alex Holm, C.B.E., F.H.A.S., M.R.A.S.E., S.E.A.C. (Dip. Hons.).

Deputy Director :

E. Harrison, M.S.A., B.Sc., N.D.A. (Hons.).

ADMINISTRATIVE AND GENERAL.

Ag. Statistical Officer : A. C. Hunter.

Accountant : H. S. Land.

Ag. Office Superintendent : E. J. Kelly.

Clerks : R. Abram, R. F. Dalziel-Armstrong, J. E. Harrison, R. F. Palmer, F. Parker, L. Myers, J. Riddell, S. G. Sharp, Mrs. M. A. Carr Hole, Miss M. M. Burge.

Junior Clerk : D. P. Herne.

Clerical Learners : F. W. Evans, K. R. Maitland, J. F. Dent, Miss M. E. Hall.

Entomologist : T. J. Anderson, M.A., B.Sc. (Hons., Edin.), F.Z.S., F.E.S.

Assistant Entomologist : T. W. Kirkpatrick, M.A., F.E.S.

Mycologist : J. McDonald, D.F.C., B.Sc. (Hons.), F.L.S.

Agricultural Chemist : V. A. Beckley, M.A.

Chemical Officer : M. H. Fox, B.Sc., A.I.C.

Plant Breeder : G. J. L. Burton, M.C., B.A.

Laboratory Assistant (Junior) : B. A. Pickering.

Laboratory Assistant (Learner) : R. N. Noble.

Senior Coffee Officer : A. D. le Poer Trench (Dip. O.A.C.).

Inspector of Plantations : H. Wilkinson, A.R.C.Sc., F.E.S.

Chief Grader and Manager of Cool Stores : C. C. T. Sharp.

Grader and Inspector : F. B. L. Butler, F.L.S., F.R.H.S.

Assistant Grader and Inspector : B. F. Ratcliffe.

Foreman Mechanic and Assistant Manager Cool Stores : D. F. Sargent.

Senior Agricultural Officer : D. L. Blunt, M.A.

Agricultural Officers : P. Booth, N.D.A., U.D.A.; R. J. Lathbury, M.A.; A. G. Bailey, B.A.

Assistant Agricultural Officers : A. S. Hartley, W. Lyne Watt, N. D. Spranger, W. G. Leckie, B.Sc.; H. J. Taylor, S.E.A.C. (Dip. Hons.).

VETERINARY.

1.—ADMINISTRATIVE AND EXECUTIVE DIVISION.

Chief Veterinary Officer : A. G. Doherty, M.C., M.R.C.V.S.

Deputy Chief Veterinary Officer : H. H. Brassey Edwards, M.R.C.V.S.

Senior Veterinary Officers : O. Dixon, M.C., M.R.C.V.S.; R. C. Wheeler, M.B.E., M.R.C.V.S.; J. T. C. Bradshaw, M.R.C.V.S

Veterinary Officers : A. W. Carter, M.R.C.V.S.; R. Scott Little, M.R.C.V.S., D.V.S.M.; R. L. Creery, M.R.C.V.S.; E. J. Mulligan, M.R.C.V.S.; W. G. Emerson, M.R.C.V.S.; E. A. Wilshaw, M.R.C.V.S; F. R. Hale, M.R.C.V.S., J. R. Hudson, B.Sc., M.R.C.V.S.

Temporary Veterinary Officer : G. Scade, M.R.C.V.S.

Stock Inspectors : D. Wyartt, R. A. C. Campbell, W. L. Lewis, G. White, H. E. Evans, J. Mackay, L. E. Smith, F. G. Chapman, H. Thorne, S. F. Saunders, T. Harris, F. T. O'Meagher, J. F. Greig, J. E. McDonogh, C. B. Jolley, P. H. Poolman, H. J. Vernon, C. P. Glover, J. Denwett, A. Lambie, J. H. Ward.

Temporary Stock Inspectors : A. M. Brauen, G. B. P. Curry, A. H. Moeran, A. E. Wardill, H. C. W. Guy.

2.—Division of Veterinary Research.

Chief Veterinary Research Officer : J. Walker, M.R.C.V.S.

Assistant Chief Veterinary Research Officer : R. Daubney, M.R.C.V.S., M.Sc.

Veterinary Research Officers : S. H. Whitworth, M.R.C.V.S., B.V.S. (Melb.), D.V.M. (Zurich). One vacant.

Laboratory Superintendent : A. Walker.

Laboratory Assistants : J. T. Schultz, H. J. Gray, J. R. McQueen, E. J. Hall, W. P. Bruce, F. Lyons.

Overseer : J. Burton.

Yard Foreman : J. Forsyth.

Clerks : W. White, A. E. Johnstone, A. J. Kemp, E. W. Wildman.

Clerical Learner : Miss R. M. Dennis.

Mechanic : O. Stenmark.

Storekeeper : J. Scott.

Assistant Storekeeper : G. W. Clochley.

APPENDIX C.

Report of Chief Veterinary Officer.

Staff Changes.

The Chief Veterinary Officer was on duty the whole of the year.

Major H. H. Brassey Edwards was appointed Deputy Chief Veterinary Officer on 17th July, 1926, with effect from 10th September, 1924.

Captain O. Dixon, M.C., carried out the duties of Acting Deputy Chief Veterinary Officer from 2nd October, 1926, until the end of the year, during the absence on leave of Major Brassey Edwards.

The following Officers returned to duty from leave during 1926 :—Captain O. Dixon, M.C., Senior Veterinary Officer, on 19/2/26; Captain R. C. Wheeler, M.B.E., Senior Veterinary Officer, on 26/12/26; Captain E. J. Mulligan, Veterinary Officer, on 20/1/26; Mr. R. A. C. Campbell, Stock Inspector, on 17/4/26; Mr. W. L. Lewis, Stock Inspector, on 20/6/26; Mr. J. Mackay, Stock Inspector, on 29/7/26; Captain J. E. McDonogh, Stock Inspector, on 17/4/26.

The following Officers proceeded on leave during the year :—Major H. H. Brassey Edwards, Deputy Chief Veterinary Officer, on 2/10/26; Captain R. C. Wheeler, M.B.E., Senior Veterinary Officer, on 12/6/26; Captain A. W. Carter, Veterinary Officer, on 29/5/26; Mr. F. T. O'Meagher, Stock Inspector, on 13/12/26; Mr. H. J. Vernon, Stock Inspector, on 4/9/26; Mr. S. F. Saunders, Stock Inspector, on 4/9/26.

The following Veterinary Officers arrived from England on first appointment during 1926 :—Mr. F. R. Hale, on 6/3/26; Mr. J. R. Hudson, on 12/12/26.

The following temporary Stock Inspectors were engaged locally during the year :—Mr. J. H. Ward, on 17/2/26; Mr. A. M. Brauen, on 23/4/26;; Mr. G. B. P. Curry, on 4/8/26; Mr. A. H. Moeran, on 19/8/26; Mr. A. E. Wardill, on 1/9/26; Mr. H. C. W. Guy, on 1,/10/26.

Temporary Stock Inspector, Mr. R. W. Forrester, engaged on 1/5/26, resigned on 30/9/26. Temporary Stock Inspector, Captain J. J. Dobson, engaged on 1/7/26, resigned on 10/8/26. Temporary Stock Inspector, Mr. J. L. Sim, engaged on 18/1/26, resigned on 31/8/26.

The appointment of the undermentioned Officers terminated during 1926 :—Mr. G. B. Purvis, Veterinary Officer, on 8/6/26; Mr. H. G. Ulyate, Stock Inspector, on 16/2/26; Mr. A. E. Hudson, Stock Inspector, on 28/2/26.

Mr. M. H. Reid, Veterinary Officer, died on 15/1/26. He was attached to the Kabete Laboratory for rinderpest investigations. His place was taken by Captain R. L. Creery, who remained at the Laboratory during the leave of the Chief Veterinary Research Officer. A reference to his work there will be found in the Chief Veterinary Research Officer's report.

Other officers of the field staff who were attached to the Laboratory, Kabete, for various periods during the year under review were :—Captain R. Scott Little, Veterinary Officer; Mr. J. R. Hudson, Veterinary Officer; and Stock Inspectors Campbell, Mackay and Curry.

Financial.

The comparative statement of fees paid during the past four years for protection against disease by stockowners, European and African, is of interest :—

1923	1924	1925	1926
£6,119	£11,536	£24,520	£25,639

These amounts do not include sera and vaccines purchased by stockowners direct from the Veterinary Laboratory, but include all the sera and vaccines obtained from the Laboratory by the field staff for the work paid for by the above amounts.

Mombasa and Coastal Area.

As foreshadowed in last year's report an additional Veterinary Assistant was on duty at the Coast during the year.

The following animals arrived from overseas and were railed to up-country destinations :—

Horses, 36; Pigs, 16; Cattle, 52; Cats, 7; Dogs, 118; Poultry, 395; Sheep, 185; Red Deer, 17.

Coastwise traffic arriving on Mombasa Island was :—

Donkeys, 57; Cattle, 323; Sheep and Goats, 3,196; Camels, 30.

The following stock arrived at Mombasa from up-country stations :—

Cattle, 526; Sheep and Goats, 50.

The Veterinary Station at Makupa continued to deal with stock arriving on Mombasa Island from the Mainland :—

Cattle, 3,669; Sheep and Goats, 14,550; Donkeys, 28; Pigs, 9.

Inspection of Slaughter Stock at Mombasa :—

Cattle, 4,491; Sheep and Goats, 19,457; Camels, 3.

The Medical Officer of Health reports the following condemned :—

Beef, 7,488 lbs.; Mutton, 6,204 lbs.; Pork, 18 lbs.

Inspection of Hides and Skins for Export :—

Hides, 11,985 bundles; Skins, 1,060 bundles.

An outbreak of rinderpest was investigated in the Kwale district early in the year. The infection was general over the district. It was chiefly confined to young stock and a mortality of 40 per cent. of the infected animals was reported.

The position was discussed with a meeting of the Elders at Kwale and it was decided to look into the position with regard to tsetse fly before embarking on a policy which would involve expenditure on stock which might not be warranted. A rough veterinary survey confirmed this decision as the position with regard to tsetse fly and trypanosomiasis was found to be such that stock immunised against other diseases would inevitably succumb to trypanosome infection.

East Coast Fever was found to be enzootic in Kwale, Kilifi, Malindi and Mombasa districts. It is impracticable to instal dips as the movement of stock to and from dipping tanks must hasten trypanosome infection which under present conditions is postponed as long as possible by strict limitations on movement.

There are four native assistants attached to the staff at Mombasa. These men are stationed at Kinango, Mariakani, Mazeras and Mombasa, and perform useful work in controlling movement of stock to Mombasa market, and reporting disease.

Rinderpest.

The annual report for 1925 contained an account of the forward move in rinderpest immunisation when the opinion was expressed that active immunisation by the simultaneous method was best suited to Kenya conditions. That opinion was based on the large increase in the number of animals treated by request of owners during 1925, when the inoculations increased by 300 per cent. over 1924. This very large increase in the rate of immunisation against rinderpest during 1925 has been still further increased during 1926. The opinion expressed last year therefore stands endorsed.

The total number of cattle actively immunised against rinderpest during the year was 194,306. In addition 19,391 cattle were tested for immunity by the injection of rinderpest virus alone, and 8,110 head were injected with serum alone.

The concentration of a special staff of officers and stock inspectors on the work of rinderpest immunisation was continued during 1926 and effected considerable reductions in the rate of mortality. The rinderpest service dealt with 95,606 head of the cattle immunised during the year, of which 1,949 were tested only. The mortality from these inoculations was 820 head, which compares very favourably with the total mortality for the year, which was 4,187 of the 213,697 head inoculated.

The total mortality during the year in connection with rinderpest inoculations was 4,187, and is accounted for to a great extent by hurried movement of stock to inoculating stations by natives after the disease has made its appearance in their neighbourhood. It is inevitable under such conditions that cattle in the incubative stage of the disease, but before clinical signs are manifest, are presented for inoculation.

It is worthy of note that such large numbers of stock are presented for inoculation in the face of the mortalities recorded. The explanation is that the disease in epidemic form is so severe that owners gladly accept the small percentage represented by the figures given.

In order to ensure that our method of rendering double inoculations against rinderpest embraced all modern developments in technique I arranged to visit Egypt and India during the year, while on leave, and discuss rinderpest control with the veterinary staffs in those countries. My leave was postponed however, and I therefore entrusted the work to my Deputy, who proceeded on leave towards the end of the year. At the time of writing Major Brassey Edwards had just returned with a valuable report which will, I trust, very considerably aid towards my aim of being able to render the immunisation process against rinderpest under Kenya conditions practically free from mortality.

It was of interest to note the attitude of the natives in the reserves which have taken advantage of rinderpest immunisation.

In the North Kavirondo district a local chief was much concerned that the staff should move to another location when all the cattle of his area had been immunised, protesting that the increase would require attention the following year. I further comment on this work in the reserves under the section dealing with Native Education.

The attitude towards rinderpest in the alienated areas is gradually assuming a practical one, both for stockowners and for Government. Formerly a visitation of the disease was looked upon as accidental and all outbreaks were dealt with individually by the veterinary staff; now it is generally realised that under Kenya conditions with regard to disease control it is outside practical politics to keep numbers of cattle susceptible to rinderpest.

The formation of a special inoculating staff for rinderpest inoculations has been of real benefit in getting the work of immunisation applied to practically every part of the settled areas. The position thus created cannot but be most satisfactory to stockowners, who are thus freed from anxiety of loss by sporadic outbreaks and to Government by lessening the calls for assistance, thus making for economy in veterinary administration.

That there were difficulties causing mortality in the work of immunisation during the year is unfortunately true, but they have been very few and as the causes were at once recognised it was possible to investigate remedial measures.

The problem of cattle that have been regularly dipped from birth is becoming a perplexing one for the staff dealing with inoculations. So much depends on conditions of management in addition to the actual dipping, that it is difficult to arrive at an opinion as to the state of some herds with regard to redwater and gallsickness infection. Variations in this respect in individual animals in the same herd is an additional complication.

An instance of one " dipped " farm in a district being different from the other " dipped " farms in the same area came under notice. The cattle on all the " dipped " farms were inoculated with virulent blood from the same virus producers with success, except in the case of one farm where the mortality was 10 per cent. from redwater and gallsickness.

The obtaining of a virus that will maintain its potency and be free from accidental infections such as piroplasms and anamplasms, the causal organisms of redwater and gallsickness respectively, is being investigated by the Chief Veterinary Research Officer and reference to the subject will be found in his annual report.

In the Nakuru district cattle branded as immune to rinderpest were found to be susceptible and 4,906 head were double inoculated free of charge. It was reported that the animals in question had been double inoculated and branded under the old system when such inoculations had to be undertaken by the district staff with the assistance of the stock-owners themselves. That the system was inefficient was evident to me when I created the rinderpest service for district inoculations and it is now proved conclusively to have been so.

Trypanosomiasis.

Cases of this disease were found on six farms during the year. The position in respect of tsetse fly and tsetse disease remains the same as reported last year.

Education of Natives.

It is to be regretted that the commencement of the educational work at the Central Native Training Depot at Ngong had to be delayed longer than I anticipated as the buildings were not available for the accommodation of the staff.

Although the rate of immunisation against disease amongst native stock maintained the high level of last year, it is the agricultural and semi-agricultural tribes who are taking advantage of the facilities offered. Unfortunately a different position obtains amongst the ultra-conservative pastoral people, and a tribe like the Masai, who maintain themselves entirely

by their stock, have refused steadfastly to listen to the advantages of adopting modern methods for lessening mortality from disease, which accounts for such a large wastage of their stock annually from rinderpest and pleuro-pneumonia. It is not difficult to understand the conservatism of these primitive people who by practising the stock husbandry of their forefathers have amassed sufficient stock to supply all their own needs. That their requirements are small and their cattle husbandry a very wasteful form of management of their nine million acres does not concern them. Their pride of knowledge of cattle lore, which tolerates good naturedly the ignorant stranger who does not know that grazing certain types of pasture at certain seasons, or at a particular stage of growth, is essential for proper nutrition, is commendable and valuable, but the pathetic spectacle of a 50 per cent. rinderpest mortality when immunity can be conferred by inoculation, is the other side of the picture.

A combination of the knowledge possessed by these pastoral peoples with modern scientific methods now available for application is my objective.

This successful conclusion is only possible amongst the primitive pastoral peoples of East Africa by a system of education which demonstrates successful results from disease control methods better than their own. The spoken or written word conveys nothing to a tribe like the Masai where their stock are concerned. It is equally impossible to demonstrate modern methods on their own stock as the prejudices of the elders, male and female, are so strong as to effectively nullify successful results.

I endeavoured as far as possible to utilise the rinderpest service for native education during the year under review. Natives from various reserves were attached to the staff for training. Owing to the delay in organising the central institution at Ngong, I decided to postpone native training, as proper control and preliminary instruction before pupils embark on field work, is essential.

Veterinary Stations.

North Kavirondo.

The inoculating station at Bungoma in Sudi's location continued to deal with the stock of the location. The number of native-owned stock double inoculated against rinderpest was 34,452, and 4,401 head of trade stock were similarly dealt with. In addition immunity tests were carried out on 949 head.

Kingwal (Nandi).

This station continued to inoculate against rinderpest at the request of the natives of the reserve, who brought 16,772 head for double inoculation and 12,056 head for immunity testing.

Machakos (Akamba).

This tribe was served by three inoculating centres during the year. The inoculation station at Machakos, the station at Waterfalls, and the additional temporary station at Matangatha on the Yatta Plains. Altogether 48,907 head of cattle were dealt with for rinderpest and 1,069 head of trade stock were vaccinated against pleuro-pneumonia at Machakos during the year.

Timboroa Station.

This station continued to serve the Kerio Province natives during the year. 16,054 head of cattle were brought to the station for inoculation against rinderpest during the year. In addition 1,351 head of trade stock were dealt with.

Kibigori (Central Kavirondo).

This station showed signs of renewed activity during the year. 1,738 native-owned stock were inoculated against rinderpest and vaccinated against pleuro-pneumonia, while 3,854 trade stock were similarly dealt with during the year.

Isiolo (Northern Frontier Province).

Horses and mules, sheep and goats, continued to be dealt with at this station throughout the year. 37,314 sheep and goats, and 240 horses and mules, were passed through.

Slaughter Stock.

Nairobi abattoir returns show the following numbers slaughtered during the past three years :—

1924	1925	1926
11,085	13,331	10,427

The decrease in 1926 does not mean a decrease in the quantity of meat yielded for consumption. It is explained by the smaller number of inferior cattle drawn from the Masai Reserve, and an increase in the number of properly finished slaughter oxen from the alienated areas.

The Medical Officer of Health reports 595 carcases condemned, chiefly for *Cysticercus bovis* infection (measles), 20,901 sheep and goats were slaughtered for human consumption at Nairobi during the year, of which 331 carcases were condemned. 784 pigs were slaughtered, of which 6 were condemned.

Tuberculosis.

Pulmonary tuberculosis has been reported in Masai cattle slaughtered at the Nairobi abbatoir.

East Coast Fever.

A resumé of the position with regard to the incidence of this disease in the Colony is indicated in this report.

Like redwater, gallsickness and allied infections of the blood stream, East Coast Fever depends for its existence on tick life. Complete tick eradication therefore, must lead to complete eradication of the disease.

Fencing pasture, destruction of game, and regular dipping of all stock carried on any grazing area will eliminate tick life and is within the bounds of practical farming on any land suitable for intensive cattle farming.

East Coast Fever must have existed in Eastern Africa for centuries. It first came into prominence when cattle were sent down the Coast to Rhodesia from Dar-es-Salaam during the Boer war. Koch, the German scientist, investigated it and we in Kenya first recognised the disease in 1905 near Nairobi. In the absence of any definite knowledge of cattle diseases in other parts of the Colony at that time, it was thought that Nairobi was the only centre of infection. With increase in veterinary staff it soon became evident that the condition was widespread in East Africa. We now know that the country is naturally divided into two large main areas in respect of East Coast Fever; one where the disease is enzootic, and the other where it does not exist or can only maintain itself to a limited extent under natural conditions. The boundaries of these areas have been gazetted and movement of stock regulated by Government accordingly.

No exact scientific research has yet been carried out on the point, but it is seen that in the latter area mentioned above, natural conditions of soil, climate, temperature and moisture inhibit the continuous expansion of tick life, whereas in the former (enzootic) area conditions are so favourable as to establish favourable conditions for reproduction to proceed uninterruptedly all the year round.

On examining the map of the Colony it is observed that the enzootic areas lie to the south, more particularly in the coastal area and lake basin (Victoria Nyanza). The disease becomes more rarely met with as one goes north to the areas of lighter and intermittent rainfall.

It is obvious, therefore, that the economics of East Coast Fever and measures necessary to curtail losses from it in native reserves and on farms in the alienated areas, must differ to a great extent according to locality. Fencing and dipping on valuable dairying land are economically sound measures to adopt. A different aspect of the question is presented by the presence of the disease on what might be termed " range " country, where conditions of moisture and soil do not generally favour the continuous propagation of tick life, and the regular breeding of ticks is, usually, confined to watercourses, vleis and permanently moist patches such as are found over this type of country.

It is wrong to say that ticks are not present on cattle all the year round even on this class of pasture; it is equally true, however, to say that East Coast Fever in a herd does not flourish and establish itself permanently as is the case in enzootic areas, also recourse to dipping can check and successfully terminate mortality early, which equally is not the case in the natural enzootic areas.

The explanation of what are undoubtedly puzzling conditions lies in the fact that the causal organism of East Coast Fever does not carry on its cycle through the tick egg as in the case of the parasites causing redwater and gallsickness. Both these latter diseases are omnipresent on all pastures harbouring the ticks that carry them. This is not the case with East Coast Fever. What happens is this, and it seems to explain why redwater maintains itself in all situations where the necessary tick life abounds and East Coast Fever does not :—

(1) Every fertile egg deposited by a redwater infected female tick, if hatched out, produces a larva that can at once convey redwater.

(2) Fertile eggs deposited by East Coast Fever infected female ticks do not hatch out infected larvæ. Larvæ of ticks concerned in the spread of East Coast Fever do not therefore infect with East Coast Fever until they have fed on an infected beast. After their first meal of blood containing East Coast Fever organisms, they drop to the ground and attain the nymphal stage before they are capable of spreading infection.

It is necessary therefore to have—

(*a*) an infected beast available for the seasonal hatching of larval ticks, or

(*b*) a few larval or nymphal forms left over from the previous season's hatching (adults are not concerned; in the case o fthe adult female, she lays eggs and dies; the male does not seek a second host after reaching the adult stage) in order to carry on the disease.

The constant provision of the infected beast essential for the carrying on of the infection is possible only in areas—

(1) where conditions of moisture and warmth admit of the hatching out of ticks all the year round.

(2) where numbers of susceptible stock are continually available to complete the life cycle of the causal organism.

It is clear that these conditions do not obtain over open grass country of 15-20 inch rainfall, yet on such country, valleys with moist bottoms and vleis can harbour the disease and if its presence in such places is not realised considerable losses may be incurred.

What I have said serves to illustrate the ease with which dipping can control the disease in areas of open grass lands of

light rainfall and the difficulties of making any impression on country in which tick reproduction is constant and susceptible stock are always being added to the pasture when calves are born.

The disability of tick life to maintain itself in numbers on open, dry country all the year round is due to the lack of the conditions necessary for the continuous hatching out of eggs. An engorged female tick deposits some thousands of eggs in little clumps held together by a glutinous material. As a rule even under the most favourable conditions of moisture the outer layer of eggs shrivels and acts as a protective layer to the underlying eggs. Under very dry conditions, or when the fecund female is unable to gain access to a moist stratum of soil, such as is provided by the cracks in baked ground so commonly seen in black cotton soil, the eggs deposited do not hatch out. Thus we find conditions where the regular propagation of ticks is confined to watercourses and vleis, the reproductive processes being limited to rainy seasons over the open country.

On open country a few cases of East Coast Fever will not necessarily lead to a high mortality, therefore, unless they happen to occur at a time when favourable conditions have resulted in the hatching out of a crop of larval ticks. The case of Rumuruti Township last year illustrates this. The disease occurred at a very dry time. Short interval dipping was at once put into force, thus larval forms were caught by the dipping fluid, as hatched, after the rains commenced, with the result that no further deaths from East Coast Fever occurred. This is invariably the experience when the first case of the disease is detected and dipping at once resorted to. The importance of knowing the cause of mortality in the case of every death amongst cattle on a farm where regular dipping is not practised cannot be overestimated. It is usual, however, to find that East Coast Fever is not suspected until an abnormal mortality has occurred by which time the numbers of infected larval and nymphal ticks is probably so high that a large mortality is inevitable and will continue, in spite of dipping, until all the infected ticks are killed. During the year herds have been practically wiped out in spite of three-day dipping.

A very few infected East Coast Fever cattle can provide infection for many thousands of larval ticks which remain on the animals a few hours only and are afterwards infective.

We have therefore to consider systems of dealing with East Coast Fever applicable to separate areas differing as regards topographical and climatic conditions. It is along these lines that this question must be approached.

As indicated above, the country from the point of view of this disease is divided into two classes of country :—

(1) Classed as infected;

(2) Classed as non-infected.

The infected or " dirty " areas of the Colony where the disease is always present carry about the same numbers of horned stock as the areas which are classed as non-infected. This is a point of great importance and one which I feel deserves comment.

The areas of the Kavirondo and Masai tribes make an interesting comparison in this respect. Kavirondo country, where East Coast Fever infection is always present on practically all the grazing grounds, carries about double the number of horned stock as Masai country where the infection lies on comparatively small areas.

We have proved that calves born on infected pasture contract the disease naturally while young and subsequently preserve a complete immunity through life. The efforts that are being made to confer an immunity similar to that obtained in this natural way are detailed in the report of the Chief Veterinary Research Officer.

945 head of cattle were exposed to natural infection at Waterfalls Veterinary Station and tested on their immunity before being branded with the official brand to denote their origin in an enzootic area.

The position with regard to East Coast Fever in the Colony has, during the period under review, gradually taken on the aspect as represented. It is inevitable that two schools of thought should develop within the ranks of cattle breeders on this question which is of the utmost importance to the future of the industry. One school considers tick eradication by dipping and control of movement by fencing to be sound measures for dealing with East Coast Fever, while the second school believes that the solution lies in immunity.

I would like briefly to review a few of the aspects thus created.

East Coast Fever control and ultimate eradication is possible by the first method on small areas. Over large areas inhabited by primitive stock owners it must be considered to be inapplicable at the moment. With education and advancement our work on rinderpest in the Native Reserves (especially the financial side of it) entitles us to look forward to the future confident that if the solution is ultimately found to be dipping it will be capable of application. The arid areas of " range " country where water conditions and frequent movement of the stock of nomadic pastoral tribes would make regular dipping impossible during the seasonal grazing on such pastures fortunately, as I have explained, do not admit of this disease amounting to a serious condition, as such country is inhospitable to tick life and frequent movement precludes the possibility of infection being maintained to any degree of importance.

The second school of thought which bases its argument on life immunity artificially conferred is undoubtedly the popular

one. The method as advanced by the Chief Veterinary Research Officer in his report depends on two main factors. The first is infected material with which the animals to be immunised are inoculated. The second is a supply of infected ticks to convey the causal organism to the animals under treatment by biting in the natural way. The second part of the process can be carried out by exposing the animals to infection on pasture known to be heavily infested with infected ticks or by placing infected ticks on the cattle by hand. Given sufficient numbers of infected cattle to supply the infected material and sufficient infected ticks for the second part of the process, the method can be applied in practice. At the moment the difficulties of the method (appreciated by a perusal of Mr. Walker's report) and the uncertainty of the immunity conveyed all tend to delay its release into the field of practical application.

Both schools, therefore, have great difficulties to contend with which may be summarised as follows.

Primitive stockowners and the game and vermin animals using the pastures with domesticated stock are the drawbacks to be overcome by the dipping advocates; large tracts of uninhabited land, forests, etc., are a great drawback also.

Difficulties in the way of a practical immunising process to be solved by the research workers stand in the way of the second school.

In the one case the difficulties are known, in the other they are not. At the time of writing (May, 1927) I have an application before me, from the elders of three locations of a tribe inhabiting an enzootic East Coast Fever area, for assistance to build cattle dips which they propose to finance from tribal funds. My staff are immunising stock to rinderpest in this particular reserve, but the beneficial effects of dipping have been demonstrated to these natives on farms where cattle dipping is practised on the borders of their country.

RETURNS FROM GOVERNMENT DIPPING STATION FOR 1925 and 1226.

	1925			1926		
	Equines	Cattle	Sheep and Goats	Equines	Cattle	Sheep and Goats
Nakuru ..	741	9,823	10,868	251	7,620	10,099
Naivasha ..	—	—	10,263			
Isiolo	1,614	—	73,282	260	—	37,314
Nyeri	24	1,073	150			
Nanyuki ..	124	21,384	—	88	24,551	—
TOTAL ..	2,503	32,280	94,563	599	32,171	47,413

Horses : 1,604 decrease ; Cattle : 109 decrease ;
Sheep and Goats : 47,150 decrease.

RETURNS FROM THE AGRICULTURAL CHEMIST FOR ANALYSES OF DIPPING FLUIDS FOR 1925 & 1926.

Class	Error in Strength	1925	1926
Sufficiently correct.	Not exceeding 10 per cent	38.5%	40.1%
Seriously wrong.	11% to 20%	24.0%	24.5%
Dangerously wrong.	Exceeding 20%	37.5%	34.9%
Total Number of Samples Analysed ..		467	547

Three samples received were too dirty to analyse.

Contagious Bovine Pleuro-Pneumonia.

Outbreaks of this disease in the alienated areas showed a decrease, only eleven being recorded, as shown in the following comparative statement :—

	1924	1925	1926
Nakuru	1	...	1
Uasin Gishu and Trans Nzoia ...	8	10	9
Lumbwa ...	4	2	1
Nyeri	...	1	...
	13	13	11

The Laboratory issued 274,697 doses of pleuro-pneumonia vaccine during the year.

The following vaccinations with pleuro-pneumonia vaccine were carried out in native reserves during the year :—

Kibigori (Kavirondo)	4,024
Bungoma (Kavirondo)	3,550
Nandi	8,633
Machakos Akamba	1,278
Timboroa (Kerio)	17,726
Isiolo (Northern Frontier Province)	1,940
	37,151

Anthrax.

The number of outbreaks recorded for the year is seven as against thirty-eight for the previous year. These reports coming chiefly from the alienated areas do not convey the true position with regard to the disease generally in the Colony as indicated in the cases of human anthrax from the native reserves. It is pleasing to record the increase in the rate of vaccination against anthrax as reflected in the issue of anti-anthrax vaccine from the Laboratory. There were 15,833 doses as against 8,634 doses issued during 1925. This vaccine

is used in the areas where anthrax is recognised and reported and the increased use of it is clearly responsible for the large decrease in the number of outbreaks reported.

Blackquarter (Quarter Evil, Black Leg).

This disease is increasingly recognised as a cause of loss by the more intensively farmed areas. Its seriousness is recognised in a practical form by stockowners who used 49,658 doses of vaccine for preventive inoculation, manufactured at the Veterinary Laboratory. The quantity of this vaccine used during 1925 was 21,900 doses.

CANINE DISEASES.

Piroplasmosis (tick fever) continues to cause mortality in susceptible animals. Trypanblue when used in time is still considered to be the best treatment.

Rabies was not reported during the year.

Thirty-four imported dogs were detained in quarantine at the Nairobi Veterinary Station.

BRANDS ORDINANCE, 1907.

The following are the particulars of brands registered, transferred and cancelled during the period under review :—

Brands registered	230
Brands transferred	11
Brands cancelled	118
Departmental Brands	—
Private Brands	230
" S " Brands	131
" S " Brands Administrative ...	—
Numerals—Private	—
,, Departmental	29 sets.

DISEASES OF EQUINES.

Ulcerative Lymphangitis.

Better stable management is indicated as causing a very large decrease in the number of cases of this disease :—

1924	1925	1926
53	104	38

Epizootic Lymphangitis.

A comparative table shows a decrease in the number of cases :—

1924	1925	1926
13	24	17

Horsesickness.

Thirteen cases were reported during the year.

Livestock Importations.

The livestock importations through the ports of Mombasa and Kilindini are as follows, and the returns for 1923, 1924 and 1925 are added for purposes of comparison :—

	1923	1924	1925	1926
Horses	30	18	34	37
Mules	1	9	6	—
Donkeys	20	111	47	47
Cattle	323	364	906	52
Sheep and Goats ..	4,324	6,540	4,939	339
Pigs	12	58	32	16
Dogs	68	76	100	118
Cats	17	7	8	7
Poultry	219	319	240	395
Deer	—	—	—	17

The above importations include 45 pure-bred bulls, and 7 pure-bred cows and heifers.

A. G. DOHERTY,
Chief Veterinary Officer.

APPENDIX D.

Report of Chief Veterinary Research Officer.

A. STAFF MOVEMENTS.

The following Officers proceeded on vacation leave during the year :—

Mr. J. Walker, Chief Veterinary Research Officer.

Mr. A. Walker, Laboratory Superintendent.

Mr. H. G. Gray, Laboratory Assistant.

Mr. J. Forsyth, Yard Foreman.

The following Officers returned from vacation leave :—

Mr. J. Walker, Chief Veterinary Research Officer.

Mr. A. Walker, Laboratory Superintendent.

Mr. A. J. Kemp, Clerk.

Mr. J. Burton, Overseer.

Mr. J. R. McQueen, Laboratory Assistant.

Transfers.

Mr. J. S. McDonald, Laboratory Assistant, was transferred to the Medical Research Laboratory on 8th March, 1926.

New Appointments.

Miss R. M. Dennis was appointed Junior Clerk and Telephonist on the 1st January, 1926, *vice* Miss N. Judd, resigned.

Mr. E. Wildman was appointed to the Clerical Service, II Grade, on the 8th September, 1926.

Mr. F. Lyons was appointed to the post of temporary Laboratory Assistant with effect from the 1st October, 1926.

Acting Appointments.

Mr. R. Daubney, M.Sc. (Wash.), M.R.C.V.S., F.Z.S., Assistant Chief Veterinary Research Officer, was appointed to the post of Chief Veterinary Research Officer during the absence on vacation leave of Mr J. Walker, from 4th June, 1926, to 17th December, 1926.

Dr. S. H. Whitworth, D.V.S. (Zurich), B.V.Sc. (Melb.), M.R.C.V.S., Veterinary Research Officer, was appointed to the post of Assistant Chief Veterinary Research Officer during the period Mr. Daubney acted as the Chief Veterinary Research Officer.

Mr. W. White, Clerk, acted in the post of Laboratory Superintendent during the absence on vacation leave of Mr. A. Walker, from 27th May, 1926, to 31st December, 1926.

Vacancies.

One vacancy for a Veterinary Research Officer remained unfilled throughout the year.

B. ADMINISTRATIVE ACTIVITIES.

Correspondence.—3,155 inward and 2,769 outward communications were dealt with during 1926, a total of 5,924. This is exclusive of communications received and despatched in connection with slides and specimens submitted for examination, or the numerous letters and papers sent to the Laboratory for minuting.

Reports on 18,335 slides and specimens were typed and sent out during the year, an increase of 8,507 over the preceding year.

Laboratory Farm.

80 acres of land was under cultivation in connection with the production of foodstuffs for laboratory animals during the period under review, viz. :—

20 acres green maize;

60 acres green bean forage.

The farm labour was also employed throughout the year on the maintenance and upkeep of roads, fences, grazing land, transport of fuel, stone, murram, etc.

A breeding herd was maintained on the Lower Farm for the purpose of breeding calves for special experimental work. 61 calves were born of this herd during the year, consisting of the following, viz. :—

	23 bull calves
	38 heifer calves
Total ...	61

C. BUILDINGS AND PLANT.

Buildings.

The new wing to the Laboratory was completed by the contractors during the year. The installation of piping and fittings for gas, steam and water in this wing was carried out by the laboratory mechanic and his staff. Other work on buildings carried out by the laboratory workshop staff included the following :—

Commencement of erection of a steel and concrete isolation building for anthrax experiments, and for the preparation of a new anthrax spore vaccine. The removal of all fittings, etc.,

from old store (which was too small for present requirements) and their re-erection, together with additional fittings, in a much larger building.

The conversion of the old store into a washing-room for serum bottles.

The erection of a collecting pen for serum-making cattle at entrance of bleeding hall in new wing.

New incinerator built for disposal of refuse.

Post-mortem room refitted with new concrete benches, washstands, floor, etc.

Grain store rebuilt and rendered rat-proof.

The maintenance and repair of laboratory, boma and farm buildings, staff quarters, etc.

Plant.

The steam, gas and electrical plants were maintained in good order, and kept running throughout the year. Certain new items of apparatus for use in conjunction with the plant were installed in the laboratory. The apparatus and machinery generally were kept in an efficient state of repair.

General.

General work carried out in our workshop included repairs to transport vehicles, farm implements, etc., the making of serum and other packing cases, bookcases for library, feeding troughs, and various appliances for laboratory use.

Further improvements were effected in the drainage, water and sanitary systems.

D. FINANCE.

Expenditure.

The amount originally sanctioned for this division for 1926 was £29,458. Owing to increased anti-rinderpest serum production, a further £2,350 was voted in the supplementary estimates, making a total of £31,808. It was found possible to effect savings in certain votes other than those connected with sera and vaccine production, and the actual expenditure for the year was £29,689.

Revenue.

The revenue realized from the direct sale of laboratory products was approximately £4,200. This is exclusive of revenue accruing from laboratory products issued for inoculations in the field, such revenue being credited in the books of the Veterinary Division. The value of anti-rinderpest serum issued to the field staff during 1926 amounted to £25,654.

The total value of laboratory products issued during the year, for which charges are gazetted, is £29,860. Other products to the value of £1,950 were manufactured and issued free of charge.

LIVESTOCK.

Species.	On Books 31-12-25.	Received during 1926.	Remaining on Books, 31-12-26
Horses ..	4	1	4
Mules ..	24	6	22
Donkeys ..	—	—	—
Cattle ..	610	898 (includes 81 births)	692
Sheep ..	52	27 (includes 7 births)	56
Goats ..	20	12 (all births)	28
Pigs ..	24	31 (includes 19 births)	27

TECHNICAL ROUTINE.

The number of slides and specimens submitted for examination totalled 18,335.

The classification of the diagnoses arrived at is as follows :

BOVINES	TOTAL EXAMINED	17,861
Anaplasmosis	2,329	
Anaplasmosis and Redwater	19	
Anthrax	51	
Blackquarter	9	
Broncho-pneumonia	1	
Contagious Abortion	89	
Contagious Abortion, suspicious	9	
Contagious Abortion, doubtful positive	25	
Contagious Abortion, very doubtful positive	4	
Colon Bacillosis	49	
Contagious bovine pleuro-pneumonia	97	
East Coast Fever	697	
East Coast Fever and Redwater	23	
East Coast Fever, suspicious	13	
Pneumonia and Pleurisy	1	
Pneumonia	2	
Paratyphoid infection	73	
Redwater	358	
Redwater and gall-sickness	16	
Rinderpest	3	
Small Piroplasms	843	
Streptothricosis	8	
Spirochætes	4	
Trypanosomiasis	64	
Trypanosome theileri	2	
Tuberculosis	1	
Awaiting diagnosis	18	
Negatives	13,053	
EQUINES (HORSES)	TOTAL EXAMINED	163
Biliary Fever	1	
Epizootic Lymphangitis	10	
Streptothricosis	2	
Ulcerative Lymphangitis	54	
Ulcerative Lymphangitis, suspicious	4	
Ulcerative and Epizootic Lymphangitis	1	
Awaiting diagnosis	1	
Negatives	90	

EQUINES (MULES)	TOTAL EXAMINED	45
Anthrax	1	
Epizootic Lymphangitis	3	
Trypanosomiasis	1	
Ulcerative Lymphangitis	10	
Ulcerative and Epizootic Lymphangitis	1	
Awaiting diagnosis	3	
Negatives	26	
EQUINES (DONKEYS)	TOTAL EXAMINED	25
Trypanosomiasis	4	
Ulcerative Lymphangitis	1	
Negatives	20	
EQUINES (ZEBRA).....	TOTAL EXAMINED	
Negatives	3	
CANINES	TOTAL EXAMINED	55
Tick Fever	17	
Trypanosomiasis	1	
Negatives	37	
CAPRINES	TOTAL EXAMINED	14
Sarcoptes Scabies.....	1	
Laikipia Lung Disease	2	
Negatives	11	
OVINES	TOTAL EXAMINED	70
Oestrus ovis	1	
Pneumonia and Pleurisy	2	
Laikipia Lung Disease	2	
Purulent Pneumonia	1	
Pneumonia.....	4	
Pleurisy	1	
Streptothrix infection	1	
Negatives	58	
AVIANS (FOWLS)	TOTAL EXAMINED	57
Endocarditis	1	
Egg-bound.....	2	
Fowl Typhoid (Kikuyu Fowl Disease)	11	
Leukæmia	1	
Peritonitis	5	
Tumour on the uterus	1	
Rupture of egg-sac with Peritonitis	2	
Tuberculosis	1	
Enteritis	1	
Diphtheritis Roup	1	
Negatives	29	
Sarcoma of Liver	1	
Roup	1	
AVIANS (TURKEYS)	TOTAL EXAMINED	10
Fowl Typhoid (Kikuyu Fowl Disease)	4	
Egg-bound.....	1	
Enteritis	1	
Negatives	4	
PORCINES	TOTAL EXAMINED	15
Broncho-pneumonia.....	1	
Negatives	14	
CAMEL	TOTAL EXAMINED	4
Negatives	4	

BUCK	TOTAL EXAMINED	1
Negatives	1	
SNAIL	TOTAL EXAMINED	1
Awaiting diagnosis	1	
TICKS	TOTAL EXAMINED	4
Hyalomma ægyptian	1	
Amblyomma variegatum	1	
Negatives	2	
LAPINES	TOTAL EXAMINED	7
Negatives	7	

SYNOPSIS OF SPECIMENS FOR DIAGNOSIS.

A.	Blood samples for Pleuro-pneumonia diagnosis test	8,163
B.	„ „ „ Contagious Abortion diagnosis test	649
C.	Blood and organ smears, tissue and other specimens	9,523
		18,335

A. Of the 8,163 blood specimens received for Pleuro-pneumonia serum diagnosis test, 80 were positive and 8,083 negative.

B. Of the 649 blood specimens for Contagious Abortion test, 81 were positive, 36 doubtful, and 532 negative.

C. Of the 9,523 blood and organ smears, etc., received, 9,217 were from bovines, of which 4,779 were positive, and 4,438 negative.

Of the 4,779 positives, the following table gives the numbers of specimens and the diagnoses, in the cases of those received from Private Owners, Nairobi Veterinary Quarantine Station, and outside Veterinary Quarantine Stations, and the number of negatives (total 4,438) from the same sources.

	Private Owners	Nairobi Veterinary Quarantine Station	Outside Veterinary Quarantine Stations	Total
Anaplasmosis	56	2,267	6	2,329
Redwater	72	103	183	358
Piroplasmosis other than redwater	343	423	48	814
East Coast Fever	368	—	329	697
Trypanosomiasis	62	—	2	64
Anthrax	45	—	6	51
Blackquarter	7	—	2	9
Colon Bacillosis	49	—	—	49
Paratyphoid	73	—	—	73
Others	335	—	—	335
TOTAL ..	1,410	2,793	576	4,779
Negatives	1,737	1,945	756	4,438
			TOTAL ..	9,217

PREPARATION OF LABORATORY PRODUCTS FOR THE YEAR ENDED 31st DECEMBER, 1926.

Products.	Balance on hand 31-12-25	Prepared by Laboratory during the Year.	Issues for Year.	Returned to the Laboratory.	Written off, (too old for use).	Balance on hand 31-12-26.
Anti-rinderpest serum	4,042,350	19,122,200	14,241,050	423,750	47,250	9,300,000 c.c.
Blackquarter vaccine, 1st	3,190	28,440	29,620	1,060	—	3,070 doses.
Blackquarter vaccine, 2nd	3,330	28,270	29,658	1,060	—	3,002 ,,
Trypanblue, Canine	147	165	282	—	—	30 ,,
Trypanblue, Bovine	68	681	727	210	—	232 ,,
Colon Bacillosis vaccine	1,803	6,452	7,963	212	267	237 ,,
Kikuyu Fowl (Fowl Typhoid) Disease ..	—	15,598	15,598	—	—	Nil.
Ulcerative Lymphangitis	84	243	224	—	—	103 courses.
Anthrax vaccine, 1st	29,924	37,280	15,713	880	31,871	20,500 doses.
Anthrax vaccine, 2nd	23,124	33,480	15,833	2,680	26,511	16,940 ,,
Bluetongue vaccine	14,794	—	600	400	—	14,594 ,,
Wireworm Remedy	119,200	398,000	455,100	2,000	—	64,100 ,,
Pleuro-pneumonia vaccine	—	274,697	274,697	—	—	— ,,
Redwater-Anaplasmosis vaccine	—	193	193	—	—	— ,,
Sheep-pox vaccine	—	7,100	7,100	—	—	— ,,
Laikipia Lung Disease vaccine	—	31,043	31,043	—	—	— ,,
Contagious Abortion vaccine	—	1,240	1,240	—	—	— ,,
Paratyphoid vaccine	—	2,008	2,008	—	—	— ,,
Paratyphoid serum	—	298	298	—	—	— ,,

DETAILS OF ISSUES ARE SHOWN BELOW.

PRODUCTS.	Stockowners.	Departmental.	Other Countries.	Laboratory Experiments	Total Issues.
Anti-rinderpest serum	303,250	12,827,050	1,100,000	10,750	14,241,050 c.c.
Blackquarter vaccine, 1st	21,450	6,970	1,200	—	29,620 doses.
Blackquarter vaccine, 2nd	21,488	6,970	1,200	—	29,658 ,,
Trypanblue, Canine	77	205	—	—	282 ,,
Trypanblue, Bovine	60	667	—	—	727 ,,
Colon Bacillosis vaccine	7,782	181	—	—	7,963 ,,
Kikuyu Fowl Disease (Fowl Typhoid) vaccine	15,598	—	—	—	15,598 ,,
Ulcerative Lymphangitis	84	140	—	—	224 courses.
Anthrax vaccine, 1st	8,370	7,343	—	—	15,713 doses
Anthrax vaccine, 2nd	8,130	7,703	—	—	15,833 ,,
Bluetongue vaccine	600	—	—	—	600 ,,
Wireworm Remedy	418,200	20,100	16,800	—	455,100 ,,
Pleuro-pneumonia vaccine	52,451	215,396	6,850	—	274,697 ,,
Redwater and Anaplasmosis vaccine	148	45	—	—	193 ,,
Sheep-pox vaccine	7,100	—	—	—	7,100 ,,
Laikipia Lung Disease vaccine	31,043	—	—	—	31,043 ,,
Contagious Abortion vaccine	1,240	—	—	—	1,240 ,,
Paratyphoid vaccine	2,008	—	—	—	2,008 ,,
Paratyphoid serum	298	—	—	—	298 ,,

TECHNICAL RESEARCH.

(1) DISEASES OF CATTLE.

(A) RINDERPEST.

(1) *Preparation of Vaccine.*

The desirability of carrying out research work with a view to the introduction of a vaccine for the immunisation of cattle against rinderpest was considered and it was decided to instal in the new wing the necessary plant for the purpose of carrying out this work.

The plant arrived during the course of the year and when the installation of the power from Nairobi is completed it will be possible to make a commencement.

(2) *Elimination of Redwater-Gallsickness infections from Rinderpest virus.*

For the supply of virulent blood for the immunisation of cattle born and reared on farms on which the cattle are dipped regularly from or shortly after birth, the usual procedure is to obtain the virus from a young beast born and reared on the farm which has been dipped regularly and infect it by contact with a beast reacting to the inoculation of laboratory virus.

This method has not always given satisfactory results, inasmuch as the selected virus-maker may have recovered from both redwater and gallsickness (experience having shown that some of the animals born and reared on farms on which dipping is regularly carried out from birth do not escape natural infection) in which case its blood would transmit both redwater and gallsickness to any susceptible cattle of the regularly dipped herd.

In order to determine whether an animal selected for virus-making is susceptible or otherwise to redwater, its blood is microscopically examined for parasites, but if at all present they are usually only to be found after a prolonged search, or may escape observation, it sometimes occurs that the rinderpest reaction is responsible for a recurrence of redwater, in which case there is no difficulty in finding redwater parasites in the peripheral blood and ascertaining whether the selected beast is a recovered animal; the microscopical examination of the blood for the purpose of determining whether an animal is susceptible or otherwise is, however, insufficient. Inoculation of a few c.c. of blood to a susceptible beast and observing whether a reaction occurs could be made use of, but this presents obstacles owing to the difficulty of obtaining known susceptible cattle and the delay which must necessarily occur before a definite decision could be arrived at. Newly born calves might likewise be used, but since inoculation does not always produce a definite temperature reaction and redwater parasites may occur only in rare numbers in the peripheral circulation, this method is not always reliable.

In view of the risks involved in inoculating rinderpest blood, obtained from cattle recovered from redwater and gall-sickness, to cattle born and reared on farms on which dipping has been regularly carried out from or shortly after birth, experiments were commenced to determine :—

(1) Whether the injection of the virus-maker with trypanblue at the commencement of the temperature reaction will be of assistance in overcoming the risk of transmitting redwater.

(2) Whether it is possible to eliminate the redwater and gallsickness by altering the physical properties of the blood or by other means.

Rinderpest Virus.

Attempts have been made to cultivate the virus of rinderpest by making use of modifications of the technique employed by Gye in his work on the virus of cancer; modifications of Boynton's method have also been tried. Up to the present it has not been possible to obtain evidence of growth by any of these methods.

In view of the findings of Gye and Barnard as to the activation of cultures of the virus of certain tumours by the addition of chloroform-treated extracts of tumours, the activation of high dilutions of virus by the addition of chloroform-treated extracts of infected spleen, has been attempted. The results so far obtained indicate that no marked activation is brought about by the addition of the chloroform-treated extracts.

These investigations are being continued.

It is well known that the separation of rinderpest virus from blood by filtration is a matter of extreme difficulty, and that, from the practical point of view, such a separation would be of great value, since one might be able to perform inoculations without the attendant risk of inoculating redwater parasites with the virulent blood. With this object in view filtration of blood for the separation of rinderpest virus has been attempted by the most modern filtering techniques; but the virus has failed to pass either through porcelain filters, or through filters of the asbestos press type, under the most favourable conditions for filtration. A more complete investigation of the physical properties of rinderpest virus is being undertaken in the hope that one may obtain information of value to workers attempting to separate the virus from the blood, or to produce a vaccine for this disease.

To ascertain what factors influence the serum output of an animal.

Captain R. L. Creery, Veterinary Officer, during the period he was posted to the laboratory, viz. : June to December, 1926, made and recorded the following observations in connection with the above :—

(1) That the first bleeding after hyperimmunisation, generally speaking, produces less serum.

The bleedings are at present arranged so that the first bleeding after hyperimmunisation is made on a Tuesday, which explains why the total serum output on a Monday exceeds the serum output on a Tuesday from a given number of serum-makers.

(2) That the output of serum was increased when the cattle were being fed liberally with green food.

(3) As regards the output of serum from grades in comparison with native cattle, no marked difference was noted; one of the best serum-producers amongst the mob was found to be a native.

(B) EAST COAST FEVER.

For some time past I have been investigating the possibilities of immunising cattle in Kenya Colony against East Coast Fever with a view to (1) reducing the losses from natural infection, (2) conferring immunity to cattle detained for transport work and for use on infected farms.

The method employed being the intrajugular injection of spleen pulp followed by exposure to natural infection. Cattle varying in age from unweaned calves of a few weeks to two years old and upwards were put in experiment.

The most satisfactory results were obtained with cattle from approximately two years to four years which had recovered from redwater and gallsickness or which had been artificially immunised against both these.

It was found :—

(1) Whereas the injection of spleen pulp of an infected East Coast Fever beast which had recovered from redwater and gallsickness did not necessarily transmit redwater, provided redwater parasites were not visible microscopically in the spleen pulp, the injection of spleen pulp showing redwater parasites invariably produced redwater in susceptible cattle and sometimes a reaction in cattle previously recovered from redwater.

(2) Anaplasmosis was usually transmitted to susceptible beasts, the reaction commencing about the 30th day after inoculation, consequently if cattle are exposed on or about the 14th to 18th day after inoculation to East Coast Fever tick infection, the anaplasmosis reaction may be complicated with the East Coast Fever *exposure* reaction or *vice versa*.

Inoculated cattle which are susceptible to but escape redwater when inoculated with spleen pulp, contract redwater about the third week after exposure to natural infection and

hence there is a possibility of the East Coast Fever *exposure reaction* being complicated with the redwater reaction or *vice versa*.

Theoretically speaking, cattle exposed to tick infection contract the following in the following sequence after birth :—

(1) East Coast Fever,
the incubative period of which averages about 13 days;

(2) Redwater,
the incubative period of which averages about 15 days;

(3) Spirillosis,
the incubative period of which averages about 17 days;

(4) Conderia mutana,
the incubative period of which averages about 50 days;

(5) Anaplasmosis,
the incubative period of which averages about 50 to 70 days.

It is thus possible for East Coast Fever to be complicated with these infections, more particularly with redwater and spirillosis, both of which produce an anæmia and usually do not in themselves cause a heavy mortality in young cattle, but are nevertheless responsible for an increase in the death rate when associated with or following shortly after the East Coast Fever reaction, or *vice versa*.

Under the conditions of the practice it would be difficult to guard against the risk of East Coast Fever being complicated with redwater, spirillosis and anaplasmosis or *vice versa* in susceptible cattle when exposed to tick infection. For these reasons it is essential that cattle submitted for East Coast Fever immunisation should have previously recovered from natural infection with redwater-gallsickness or from artificial immunisation.

Unsatisfactory results were obtained with unweaned calves and with weaned cattle varying in age from several months up to 15 to 20 months old or thereabouts. In such the East Coast Fever reaction was frequently complicated with a recurrence of redwater and spirillosis infections which, together with the unfavourable field conditions, were responsible for a larger percentage of losses in comparison with older cattle, but further experiments are now in progress to compare the value of the following methods of immunising—

(*a*) newly-born unweaned calves,
and

(*b*) newly-born hand-reared calves,
viz. :—

(1) Infesting immediately after birth with a few infected nymphæ or adult ticks;

(2) Inoculation in the jugular shortly after birth with redwater-gallsickness vaccine, and intrajugular injection of spleen pulp of an infected East Coast Fever beast susceptible to redwater and gallsickness and 14 days later infecting them with infected nymphs or adults;

(3) Injection of an emulsion of nymphal or adult ticks which engorged as larva or nympha on an infected beast and which after moulting are fed for 96 hours before emulsifying.

Theiler has recently shown that larvae which engorged on an infected beast and which after moulting into nymphs fed for 96 hours and nymphs which engorged on an infected beast and which after moulting into adults fed for 96 hours will when macerated and inoculated intra-jugularly produce a mild reaction to East Coast Fever.

The calves are being kept from birth in a tick-free enclosure provided with a shed as a protection against any unfavourable weather conditions. The mothers of unweaned calves are allowed to have access to their calves when necessary; they are grazed in a practically tick-free camp during the day, kept in the enclosure with their calves during the night, dipped and hand-dressed every three days to eliminate the risk of any ticks which attach to them escaping and infesting the enclosure; under these conditions it is not possible for the calves to become tick infested, and the risk of the mothers becoming infested with infected ticks is avoided.

The results of immunisation experiments for the year ended 1925, and also the results of exposure and re-exposure of inoculated and non-inoculated cattle to natural infection up till January, 1926, were embodied in the annual report of the Director of Agriculture for the year ended 31st December, 1925.

Since then further observations on the nature of the immunity conferred to East Coast Fever by natural infection or exposure thereto in inoculated and non-inoculated cattle were concluded, the final results being as follows, which were published by the writer in bulletin form, a summary of conclusions of which is as follows :—

(1) To determine and compare the nature of the immunity conferred to East Coast Fever by natural infection or exposure thereto, in inoculated and non-inoculated cattle, 78 head were exposed, at varying periods after inoculation with spleen or spleen and gland pulp of an East Coast Fever infected beast, and subsequently re-exposed on one or more occasions, and eight head of non-inoculated cattle recovered from natural infection were re-exposed on several occasions.

All cattle utilised for the experiments were kept under close observation, early morning temperature (8 a.m.) recorded and blood and gland smears collected when the temperature showed an elevated curve, only animals in which Koch's bodies were found on microscopical examination of gland smears are shown as having definitely reacted to East Coast Fever.

During the intervals between the periods of exposure they were kept in a non-infected East Coast Fever area under daily observation.

(2) *Of the inoculated cattle* :—

12.8% reacted to the original exposure;

17.9% gave an indefinite reaction to the original and a definite reaction on subsequent exposure or *vice versa*;

19.2% reacted to the original, but not to subsequent exposure;

8.9% did not react to the original, but to subsequent exposure;

20.5% gave an indefinite reaction to the original or subsequent exposure;

20.5% did not react to the original or on subsequent exposure.

(3) *Of the non-inoculated cattle* :—

62.5% reacted to the original, but not to subsequent exposure;

12.5% reacted to the original, and to a subsequent exposure;

25% gave an indefinite reaction to the original but a definite reaction to subsequent exposure.

Conclusions :—

(1) The immunity conferred to East Coast Fever by recovery from natural infection is not always complete in inoculated and non-inoculated cattle;

(2) In some instances inoculation confers a temporary immunity against natural infection;

(3) The reaction to natural re-infection is usually not severe and may escape notice in cattle not under close observation, but sometimes a marked reaction and death occurred.

These results are of practical importance in connection with the " T " branding of cattle destined for transport work from infected to clean areas or *vice versa*, inasmuch as one exposure in a highly infected camp did not confer in all cases complete immunity; on the other hand inoculated cattle which survive an original exposure might perhaps be utilised for work purposes on infected farms, the reactions to re-exposure

being not as a rule severe. It would thus be unsafe for cattle which have been inoculated and survived one exposure in a highly infected camp to be considered as "T" branded cattle for transport purposes between infected and clean areas and *vice versa*. The advisability of branding such cattle with a distinctive brand other than the "T" brand might perhaps be considered.

Experimental immunisation of susceptible cattle is now being carried out on an infected farm, under laboratory supervision. Any work which it is proposed to undertake will be of an experimental nature and to obtain accurate data, and to carry out this work it is essential that an additional laboratory staff be provided.

East Coast Fever Immunisation.

Experimental Field Inoculation.

At the request of Mr. J. Stanning, of Inglewood, Lumbwa, an experimental field inoculation for the immunisation of cattle against East Coast Fever infection was carried out *in loco*. The history of the herd is briefly as follows :—

On April 1st, 1926, the herd consisted of approximately 256 male and female grade cattle from 1½ to 3 years old. These cattle were isolated on a particular part of the estate and were dipped every three days but hand-dressing was not carried out.

The first case of East Coast Fever was confirmed on April 17th, 1926. The mortality for the months of April, May, June and July, 1926, was as follows :—

April	...	...	...	7
May	...	...	...	27
June	...	...	...	40
July	...	...	...	33

Smears from dead animals forwarded from time to time confirmed East Coast Fever infection and the owner stated that those cattle which died and from which smears were not forwarded were clinical cases of East Coast Fever.

From 1/8/26 to 6/8/26, on which latter date inoculations were commenced, a further four animals had died and three more were sick. These were confirmed as cases of East Coast Fever by microscopical examination of gland smears. The remainder of the cattle on this date appeared healthy and in fairly good condition.

The number of cattle living on 6/8/26 was 153 head, and of these 147 were inoculated : 46 on 6/8/26 and the remaining 101 head on 10/8/26.

Four cattle died in the interval 6/8/26 to 10/8/26.

The material used for the inoculation was spleen pulp taken from a well-conditioned beast slaughtered when reacting to East Coast Fever infection. Blood and gland smears were examined and Koch's bodies found to be frequent in the latter and the absense of *P. bigeminum* and *anaplasma* infections was confirmed.

No untoward symptoms were observed as the immediate result of the inoculation and only two animals showed any distinct swelling at the site of inoculation. The swelling in each case was about 3in. x 2in. x 1in. These swellings subsided after about two weeks.

The owner very kindly arranged to take daily morning temperatures of inoculated cattle as controls. Accordingly 48 head were so temperatured, commencing from 12/8/26.

The cattle were exposed to natural infection on 18/8/26, on which date dipping was discontinued indefinitely.

On 6/9/26 the cattle were again inspected, when there were 123 head living.

Between 10/8/26 and 6/9/26, 26 head of cattle had died. From clinical observations and from the temperature charts it was considered that 15 head of these 26 were infected prior to the inoculation and the remainder possibly died from East Coast Fever as the result of inoculation.

The owner reported that a number of the cattle had shown clinical symptoms of illness between 10/8/26 and 6/9/26 in addition to these confirmed reactions observed on the temperature charts. Enlarged prescapular and precrural glands were seen in a number of the inoculated cattle. From clinical observations made by the owner and information obtained from the herd, 73 head of cattle were considered to have shown no definite symptoms of illness and these were re-inoculated on 7/9/26, an animal reacting to East Coast Fever being slaughtered for the purpose of obtaining material.

On 8/9/26, two more cattle died. After this date no cattle died until the beginning of October, when four head died. Smears were obtained from three of these cattle and redwater infection was confirmed in each case on microscopical examination. No smears were obtained from the fourth animal. Temperatures were discontinued on the 7/11/26.

The following table shows the number of cattle living on the various dates :—

6/8/26	...	...	...	153 head
10/8/26	...	...	...	149 head
6/9/26	...	...	...	123 head
7/9/26	...	...	...	122 head
9/9/26	...	...	...	120 head
9/10/26	...	...	...	116 head
7/11/26	...	...	...	116 head

Summary of Results of (1) Inoculation and (2) Exposure.

(1) *Inoculation.*

The following observations were made as the result of inoculation based on the 48 head temperatured as controls :—

Reacted to inoculation and Koch's bodies present, and lived	29.17%
Reacted to inoculation and no Koch's bodies seen, and lived	14.58%
Indefinite and negative reactions, and lived ...	43.75%
Died from East Coast Fever inoculation	10.42%
Reacted to inoculation and slaughtered for material	2.08%

(2) *Exposure.*

From 7/9/26, that is the 20th day *after exposure*, until 7/11/26, 46 head were put on daily morning temperatures by the owner, and based on this number the following observations were made :—

Reacted on exposure and Koch's bodies present, and lived	30.4%
Temperature reaction but negative smears where available	26.1%
Negative and doubtful reactions	43.5%
Died on exposure	Nil.

No deaths from East Coast Fever had occurred since 8/9/26, but the owner reported death of four head from redwater, three of which were confirmed on microscopical examination of blood smears sent to the laboratory.

Definite redwater reactions were noted in a total of six cattle on exposure and redwater parasites were observed microscopically in their blood.

The following are the days on which the redwater reactions were noted after exposure, viz. :—

51st, 52nd, 53rd, 53rd, 56th, 59th.

The majority of the cattle inoculated with spleen material had been inoculated twelve months previously with laboratory redwater-anaplasmosis vaccine, and during the period in which the controls were closely observed, *anaplasma centrale* was frequently seen on examination of the blood smears.

Conclusions.

Judging from observations made on experimental East Coast Fever immunisation at Kabete, the probability is that some of the inoculated animals had, previous to inoculation, recovered from natural infection. Notwithstanding this, the indications are that immunisation was of valuable assistance in combating the outbreak of East Coast Fever.

(C) BOVINE LYMPHANGITIS.

An extensive outbreak of bovine lymphangitis, on a farm in the Soy region, was reported by the Veterinary Officer, Eldoret; and three animals were sent to the laboratory for examination and investigation of the disease. Clinically, the disease resembles lymphangitis of equines, the common seat of the lesions being on the upper parts of the limbs, although lesions involving the lymphatic glands of the head and neck region are not at all uncommon.

The three animals despatched to the laboratory arrived on the 28th December, 1925, and were kept under observation for several months.

One of the animals was emaciated, and showed extensive lesions of the left hind leg involving the popliteal gland, the udder, and the supramammary lymphatic gland. Of the remaining two animals one had lesions on the right fore-leg, involving the lymphatic glands of that region; and the other animal was affected in the head region with the involvement of the parotid and pharyngeal lymphatic glands. In each case there were numerous specimens of the "bont" tick—*amblyomma variegatum*—attached in the neighbourhood of the lesions.

Numerous attempts were made to isolate the causal organisms from the abscesses or infected lymphatic glands; but in every case the attempt failed because of the presence of several organisms, some of which developed so rapidly on the cultures as to make a complete bacteriological examination impossible. It was observed, however, that in one of the animals at least, there was considerable systemic disturbance and that the disease appeared to be extending. It was therefore decided to await the death of this animal, as it was considered likely that internal lesions would be present.

This animal, cow 379, showed intermittent fever, the rises in temperature being very marked in the evening. During the last few weeks of life its temperature in the evening not uncommonly rose to 104° and occasionally reached 105°, contracting with the morning temperature which was generally about 100° and might occasionally be as low as 98°. The rate of respiration was increased, and the animal became progressively more emaciated. Cow 379 died on the 9th June, 1926, having been under observation for more than five months.

At *post-mortem* examination very numerous encapsuled abscesses containing partly inspissated pus were found in the lungs and thoracic lymph glands. The left supramammary lymphatic gland was considerably enlarged, its substance having been almost entirely replaced by cheesy pus. This gland was roughly ovoid and measured some nine inches in length by about five inches in maximum diameter. Both quarters on the left side of the udder were almost completely destroyed by

the infection, and the affected half of the udder was several times larger than the other half in which there were only a few isolated nodules. The lymphatics and subcutaneous tissue of the left hind leg were extensively involved.

Cultures were made from the internal lesions on the assumption that material from the internal abscesses might contain a pure culture of the causal organism. Material was also preserved for histological examination. Four guinea-pigs were inoculated, two intraperitoneally and two subcutaneously, with an emulsion made from the pus, one of the guinea-pigs inoculated intraperitoneally failed to develop any infection as a result of the inoculation; the other, together with the two inoculated subcutaneously, died on the 7th day after inoculation. At *post-mortem* examination one of the guinea-pigs that had been inoculated subcutaneously showed congestion of the uterus but no other ascertainable lesions. No growth was obtained on culture media seeded from the blood and uterus of this animal. The remaining two animals showed pus at the site of inoculation with involvement of the neighbouring lymphatics. Cultures made from the pus and lymphatic gland gave a small " gram-negative " bacillus, apparently in pure culture.

It may be remarked that similar findings have been recorded by Sheather in India, who considers that a small " gram-negative " bacillus, which he isolated from guinea-pigs that had been inoculated with pus from naturally occurring cases of the disease in cattle, is responsible for the causation of bovine lymphangitis in that country. He failed to obtain this organism in cultures made directly from the lesions of infected oxen, but recovered it in pure culture from guinea-pigs inoculated with the pus.

Histological examination of the lesions in cow 379 had meanwhile revealed the presence in the lungs, lymphatic glands and udder, of fine branching filaments which, as far as could be ascertained by microscopical examination, were present in pure culture. These filaments, which were often beaded and slightly clubbed at the ends, retained the stain when treated with strong mineral acids, a characteristic shared only by the acid-fast group of organisms to which the tubercle bacillus belongs and by certain members of the *actinomyces* group. Large clumps of these organisms could be found on the edges of young extending lesions; but they were absent from the older central parts of the lesions, whether the centre was undergoing cascation and necrosis or whether the infected tissue was being replaced by fibrous tissue. Since Nocard had in 1888 described from bovine lymphangitis, in South America, a streptothrix which appeared to conform to the characters of the group now recognised as the genus *actinomyces*, it was thought quite likely that one might here be dealing with a similar infection.

The parasitic members of the genus *actinomyces* are notoriously slow growers and no growth was detected on the solid culture media seeded from the lesions of cow 379 until two weeks had elapsed. It was then noticed that a few small, opaque, pin-point colonies were developing in most of the tubes. This growth subsequently developed the typical characters of *actinomyces*.

On the 30th June, 1926, four guinea-pigs were inoculated with small quantities of three-weeks-old culture from the lesions of cow 379, intraperitoneally and two subcutaneously.

Guinea-pig 3.—Inoculated subcutaneously, 30/6/26, with 1 c.c. of an emulsion of culture from cow 379, developed a nodule about the size of a hazel nut at the site of inoculation. On the 12th July this nodule had ruptured and pus was escaping from a small orifice, probably along the track of the inoculating needle. Smears of the pus stained by Ziehl-Neelsen's method showed numerous acid-fast branching filaments with slightly swollen ends. Pure cultures of the organism were obtained by seeding the pus on solid media. The guinea-pig recovered.

Guinea-pig 4.—Inoculated subcutaneously, on the same date and with material from the same cultures, developed a swelling at the seat of inoculation, which on the 12th July was about the size of a hazel nut. The lesion did not rupture and gradually receded.

Guinea-pig 1.—Inoculated intraperitoneally with 1 c.c. of an emulsion of culture from cow 379 on the 30/6/26, died during the night of 8/9/26. *Post-mortem* examination showed peritonitis, small white nodules on the peritoneal covering of all the abdominal organs and on the abdominal surface of the diaphragm. The nodules contained creamy pus. Smears and sections made from the nodules showed large numbers of typical acid-fast branching organisms. Pure cultures were obtained from the lesions.

Guinea-pig 2.—Inoculated intraperitoneally on the same date with the same material as guinea-pig 1, died on the 11/7/26. There was a spherical abscess of about an inch in diameter at the site of inoculation, peritonitis, innumerable small nodules on the peritoneum, on the capsules of all the abdominal organs, and on the abdominal surface of the diaphragm. Smears and sections showed large numbers of the inoculated organisms. Pure cultures were obtained from the nodules.

The findings, including the location of the lesions in inoculated guinea-pigs, are in exact agreement with the records of Nocard but are opposed to those of the more recent investigators—Vryburg, Raymond and Sheather.

Attempts to Reproduce the Disease in Cattle.

Two attempts were made to reproduce the disease in cattle by the inoculation of emulsions of culture of *actinomyces* isolated from cow 379. Bovine 619 was inoculated subcuteaneously behind the shoulder with 4 c.c. of an emulsion of culture on 9th July, 1926. On the 9th August, 31 days after inoculation, a swelling roughly five inches by five inches appeared at the site of inoculation. The swelling ruptured on the 16th August and discharged pus from which pure cultures of the organism were obtained. Although occasional rises in evening temperature were observed during the following three months this animal has shown no other signs of systemic disturbance. The local swelling rapidly diminished in size, but six months after inoculation there is still a hard subcutaneous nodule about the size of a walnut and the neighbouring lymphatic vessels are corded. Bull 723 was inoculated subcutaneously with 4 c.c. of the same emulsion of culture on the same date, 9/7/26, and a local swelling approximately four inches by five inches was apparent on 8/9/26 at the site of inoculation. The local lesion healed rapidly and diminished considerably in size, but six months after inoculation there is still a small hard subcutaneous nodule about $1\frac{1}{4}$ inches in diameter and cording of the neighbouring lymphatic vessels can be detected by palpation.

On the sixth day after inoculation the evening temperature of this animal rose from its normal of about 102° to 104°; and during the next three months this animal's temperature chart showed evening rises and marked morning remissions closely resembling those seen on the chart of cow 379. On two occasions the evening temperature reached 105°, falling in the morning to about 100°. During the fourth and fifth months after inoculation the temperature of bull 723 returned more or less to the normal, but even during the sixth and seventh months there are occasions when the difference between the morning and evening temperature on the same day may be as much as 4°. The animal remains in remarkably poor condition, though it is well fed and housed.

Another of the three animals originally received from Soy, cow 378, died on 18/6/26. This animal had become extremely emaciated and had also displayed the characteristic febrile condition. During the two months prior to its death its evening temperature was frequently as high as 104°, and its morning temperatures as low as 99°. No generalisation of the disease to the internal organs could be discovered. The material was inadvertently thrown away before cultural examination of the local lesions had been made.

The third of the animals received from Soy, cow 377, is the one in which the parotid and pharyngeal glands are affected. This animal has been under observation for more than twelve months and the local lesion at first showed a

tendency to recede. More recently the infection has extended to the intermaxillary space and the cow has become extremely emaciated. She shows the characteristic remittent febrile curve. It is extremely probable that in this case also the disease will terminate fatally. *Actinomyces* have been seen in smears of pus obtained by puncture of the parotid lymphatic gland, and pure cultures of the *actinomyces* have also been grown from the pus.

A third animal affected with disease, a young bull, 1096, was forwarded to the laboratory in September, 1926. This bull also is affected in the head region, the lesions involving the parotideal lymphatic glands. Numerous species of *amblyomma variegatum* were taken from the site of the lesions when the animal arrived at the laboratory. *Actinomyces* were found in smears from the pus and the organism was also obtained in culture from the lesions. The bull is in fairly good condition, but shows the characteristic remittent fever, its temperature varying between a maximum of 104° in the evening and a maximum of 97° in the morning.

From the observations on these four animals it is reasonable to conclude that bovine lymphangitis in Kenya is due to infection with a species of *actinomyces* in all probability identical with the organism described by Nocard in 1888 as *streptothrix farciminesus*. When the investigations are completed a certain amount of information will have been gained as to the course of the disease in untreated cases. It may also prove possible to carry out experiments that will indicate whether *amblyomma variegatum*, the " bont " tick, can transmit the disease from an infected to a healthy animal. The bite of this tick produces quite a large wound in the skin of the host animal, and it is possible that infection takes place through such wounds quite independently of the tick. At the same time it is curious that Nocard should also refer to the frequency with which ticks of this genus are found in the neighbourhood of the lesions, in South America.

That causal organism is closely related to *actinomyces bovis*, the cause of the common " wooden tingue " or " lumpy jaw " of cattle; and it is therefore possible that it might yield to the ordinary iodine therapy practised so successfully in the treatment of that disease.

While continuing these investigations the laboratory would be grateful for information as to the occurrence of cases, and for the opportunity to carry out controlled experimental treatment of affected animals.

(D) MORTALITY IN CALVES.

The investigations relating to mortality have been continued by Mr. R. Daubney, A.C.V.R.O., who reports as follows thereon :—

While paratyphoid infection appears to be by far the heaviest factor in the causation of these losses, a number of outbreaks of calf disease have been diagnosed as due to infections of bacillus coli, bacillus proteus, bacillus pyocyaneus, and delayed lactose fermenting organisms of the bacillus coli group. The clinical picture in these cases varies from that of ordinary white-scour to a condition resembling quite closely that seen in paratyphoid infection. In general, however, the animals are attacked by these less serious infections, but at an age earlier than that at which paratyphoid infection manifests itself. The former type of infection—that due to bacillus coli and related organisms—has been particularly prevalent on farms where attempts have been made to hand-rear calves; the usual history is that a calf is observed to be coughing when some five to twelve days old, the coughing is at first only noticed during feeding but later there is considerable discharge from the nostrils and evidence of lung changes. During this period the temperature of the calf usually rises to 104° or 105° and diarrhœa of the white-scour type is observed. Transient swellings of the joints, particularly the hock, knee, or fetlock, are frequently observed during this period and in some cases permanently enlarged and stiffened joints may result. Affected calves may die within a few days of the onset of these symptoms or the disease may become chronic, the calves remaining emaciated and unthrifty; in the latter case the cough is generally persistent and there are periodic attacks of diarrhœa. The calf may be permanently lame as a result of definite joint infection. On *post-mortem* examination pneumonic changes are frequently found in the lungs and the mucous membrance of the small intestine particularly, the last portion is usually more inflamed than is the case in paratyphoid infection. Examination of the articular surfaces of one of the large joints will reveal an excess of synovial fluid in the joint, sometimes purulent in consistency and frequently an extensive erosion of the articular surfaces of the joint. Diagnosis presents no difficulties when a bacteriological examination of fresh tissues can be carried out, there is almost invariably a septicæmia due to bacillus coli or one of the related organisms.

These infections do not appear always to yield readily to the ordinary bacillus coli bacterin vaccines, and the laboratory is prepared to investigate outbreaks individually and to furnish special experimental vaccines for prevention.

(E) PARATYPHOID INFECTION.

Further investigations of paratyphoid infection have been carried out during the year, with the result that a somewhat fuller account of the symptoms, the course of the disease, the lesions, and the methods of diagnosis may be given.

Symptoms of paratyphoid infection.

The first symptoms to be noticed by the herd-boy are usually dullness and inappetence. The calf is disinclined to move, the coat is staring, and there is little or no appetite. The temperature is found to be high, from 104° to 107°, and observation shows that generally at this stage the calf is constipated. There are occasional evidences of abdominal pain, and if the case is uncomplicated by *anaplasma* infection the visible mucous membrances are dark and injected.

During the first two or three days illness the temperature remains consistently high throughout the day, but on the third or fourth morning there is a remission followed by an evening rise. From this time onward the daily morning remissions are usually fairly well marked until shortly before death or complete recovery. The constipation noticeable in the initial stages of the disease usually gives place in a few days to diarrhœa, in which the faecal matter is commonly very dark brown or almost black. Blood and mucous may be present in the faeces during the attack of diarrhœa. The affected calf may continue to scour right up to the time of death or may again become constipated after a few days, suffering alternative periods of constipation and diarrhœa.

A few days after the onset of symptoms there may be a more or less profuse mucous discharge from the eyes and nostrils. Where lung lesions develop there is usually a harsh dry cough and the rate of respiration is increased.

There is considerable variation in the course of the disease as observed in a number of calves on the same farm. A few very acute cases are seen in which the duration of the disease from the first noticed symptoms to the time of death is but a matter of hours; in the majority of cases the period of illness is usually some four to nine days. Less acute cases, however, may die after an illness extending over three weeks or more. In the more chronic cases lung lesions are almost invariably a prominent feature. The mortality among affected calves is rarely less than 80 per cent., and on a heavily infected farm very few recoveries are ever observed.

In cases that are complicated by the co-existence of anaplasmosis, jaundice and anaemia may be noticeable symptoms.

Lesions.

The commonest lesion observed at *post-mortem* examination appears to be a more or less pronounced inflammation of the gall-bladder. The bile is very rarely found to be normal in colour or consistency. Its colour varies from a rather opaque pale golden yellow to a fairly deep chocolate instead of the normal olive green, while its consistency varies from that of ordinary golden syrup to a thick, dark, partly inspissated flaky cream. The wall of the gall-bladder is generally noticeably thickened, its mucous membrane swollen and roughened.

Lung lesions and enlargement of spleen are observed, each in about 25 per cent. of the carcases examined. The lesions in the lung are chiefly confined to the anterior or apical, and the cardiac lobes, with occasional involvement of the anterior portions of the main lobes. These parts of the lung may in early cases be in a state of red hepatisation; later the condition appears to be grey hepatisation with the development of small necrotic foci up to the size of an ordinary pea. A greyish serous exudate is easily expressed from the smallest bronchicles, and the necrotic foci may be so numerous as to give the lung a putrid appearance. There may be also a pronounced putrefactive odour.

The spleen may be considerably enlarged and its contents semi-fluid.

The liver (even in cases uncomplicated by anaplasmosis) is frequently enlarged and its border rounded off. Its colour may vary from the normal to a rich golden brown like that of Spanish mahogany. Small lesions, having the appearance of necrotic foci, may be present in the liver.

The intestine frequently shows areas of congestion, principally in the ilcum and first portion of the large intestine. The mucous membrane in the affected portion of gut may be swollen and deeply hæmorrhagic, but ulcers have not been observed. Frequently also the mesenteric glands above the inflamed portions of gut are considerably swollen and intensely hæmorrhagic.

A few petechiæ are not uncommonly observed in the epicardium and occasionally a small quantity of clear exudate is present in the pericardial sac.

Kidney lesions in the form of small necrotic foci or tubercles are extremely rare in the cases examined in Kenya.

The remaining organs are unchanged unless cases are complicated by redwater or anaplasmosis.

Diagnosis.

Cultivation of the bacillus from the circulating blood.—During the first period of pyroxia, *i.e.*, before the first morning remission in temperature, there is almost always bacteræmia and the disease may be diagnosed by cultivation of the organism from the circulating blood. Cultures may be made in ordinary beef bouillon or in Cumming's special medium. The laboratory now makes a practice of supplying the latter medium in small rubber-capped bottles for the collection of blood-cultures. Blood is drawn by syringe from the jugular vein and the needle of the syringe is inserted through the rubber cap to inoculate the medium. The bottle may then be packed and despatched to the laboratory by post in the ordinary manner. Cultures in these bottles may also be made from the gall-bladder of a dead calf, if the wall of the gall-bladder is sterilised with a hot knife or iron before the syringe needle is inserted. After the first morning remission in temperature it usually becomes impossible to obtain a positive blood culture until shortly before death, when the bacilli are again present in the blood-stream.

Cultivation from faeces.

In about 40 per cent. of positive cases it has been possible by the use of a special technique to cultivate the causal organism from the faeces during life. Cultivation from the faeces is more frequently successful in the earlier stages of the disease.

Agglutination of the bacillus by sick calves.

Affected calves that have been sick for periods in excess of six days, as a rule strongly agglutinate the paratyphoid bacillus, providing a readily agglutinable culture is employed for the test. The agglutination titre of sick calves varies from 1 : 200 to 1 : 2500. No agglutination is obtained with normal sera or with the sera of calves suffering from other diseases, such as "white scour."

These three methods constitute the available means of diagnosis during life, although it is advisable to take daily blood smears during the period of sickness in order to ascertain whether anaplasmosis is co-existent.

Post-mortem Diagnosis.

The lesions encountered on *post-mortem* examination of calves dying from paratyphoid infection are fairly characteristic but by no means diagnostic, since it is not unusual to find lung lesions resembling those of paratyphoid in cases of bacillus coli septicaemia following chronic "white scour."

It is always possible to cultivate the bacillus from certain of the organs and usually from the blood-stream of fresh carcases. In nearly every case cultivation from the bile is successful, generally giving a pure culture, but in a few cases colonies

of bacillus coli also appear on the plate. The organism may also be cultivated in most cases from the liver, and less certainly from one of the mesenteric glands. It has also been obtained from pleuritic exudates, from the spleen, from the kidneys, the heart-blood, and in a few cases from the bladder, direct planting of the gut contents or of scrapings of mucous membranes of the intestine gives, on occasion, almost pure cultures of the organism. In such cases enteritis is usually a well-marked clinical feature, in other cases where enteritis is slight or not present, direct planting may reveal only a very few colonies of the organism or none at all and it may be necessary to resort to the brilliant green of Browning technique to obtain a culture from the gut.

In the less acute cases agglutination can be applied as a *post-mortem* measure for diagnosis.

Small specimens of organs—unpreserved—for diagnosis, should be forwarded to the laboratory as soon as possible after death. They may be packed in clean bottles or in 3in. x 1in. specimen tubes. Blood for the agglutination test should be collected in the sterile bottles supplied for that purpose.

Characters of the organism.

Biological characters of the bacillus have been more specially worked out and the results of these observations will be included in a technical report. It might be stated, however, that more than seventy strains of the organism have been examined and the characters of these strains have been found to be stable for a number of the group. Considerably less variation has been observed between the different strains of the bacillus isolated from calves than between separate strains of another species in the group.

Reproduction of the disease by feeding paratyphoid bacilli.

It is possible to reproduce the disease in young susceptible calves by the feeding of comparatively small amounts of pure cultures of the organism. It is, however, only in a small proportion of cases that the disease so induced terminates fatally. The majority of calves recover after exhibiting a more or less severe reaction to the feeding. The feeding is followed in nearly every case by a well-marked rise of temperature. This rise may commence within two days of the administration of culture or may be delayed for a period as long as fourteen days. At the peak of the temperature curve it is usually possible to recover the bacillus in pure culture from the circulating blood, even of calves that may eventually recover.

Diarrhœa with the passage of blood and large quantities of mucous is a considerably more prominent feature in the artificially induced disease. Lung lesions have been produced in certain cases by the feeding of cultures. In all cases the

culture has been given by stomach tube to avoid any possibility of inhalation. The records of three calves fed with three separate strains of bacilli, are appended to illustrate the course of the artificially produced disease.

Calf X.734.

Born at the Laboratory Farm, 23/4/26. This calf was fed normally, that is to say it received the whole of its mother's milk. On 24/4/26, when one day old it received by stomach tube, 25 c.c. of a 24-hour-old broth culture of calf paratyphoid bacilli strain X 346. The calf was not in a very good condition at the outset of the experiment, but continued to improve daily up to the sixth day. On the sixth day the temperature rose to 104 in the evening, and rigours were noticed together with diarrhœa. The calf died on the evening of the seventh day.

Post-mortem examination showed muco-enteritis, congested liver, bile yellowish in colour, lungs hyperæmic, blood-stained froth in the bronchi, congestion of kidneys, mesenteric glands slightly swollen and oedematous. Blood smears, no parasites seen, no anaemic changes present. Cultures, paratyphoid bacilli obtained in pure culture from heart blood, lungs, liver, kidneys, and mesenteric gland. Numerous paratyphoid colonies on plates made from the gut.

Calf X.1039.

Born at the Laboratory Farm, 12/9/26. Received the whole of mother's milk. On 16/9/26, when four days old, this calf received by stomach tube 20 c.c. of a 24-hour-old broth culture of paratyphoid bacilli strain 9444. A typical thermal reaction developed during the second and third weeks. On the twelfth day after feeding, the morning temperature rose to 106.2, and the paratyphoid bacilli were recovered in pure culture from circulating blood taken from the jugular vein. The temperature remained fairly high with occasional more or less morning remissions during the following four weeks. Diarrhœa of the "white scour" type was noticeable during the fourth week. During the fifth week the "white scour" gave way to a dark-coloured fœtid diarrhœa, accompanied by the discharge of a considerable quantity of mucous. At this time there was a profuse discharge from the eyes. The calf became progressively weaker, and at the commencement of the sixth week the rate of respiration was increased; shortly afterwards areas of dullness could be detected in the anterior lobes of both lungs. Calf X 1039 died on the forty-ninth day after administration of the culture.

Post-mortem examination showed congestion, evidence of diarrhœa, enteritis, inflammation of the gall bladder, bile thick, opaque, and golden in colour. The apical lobes of both lungs were consolidated with a profuse greyish exudate in the bronchials.

Blood smears, no parasites seen, no anæmic changes. Cultures, paratyphoid bacilli obtained in pure culture from the liver, lung, and mesenteric glands.

Calf X.1170.

Privately owned, hand-reared calf, thirty-eight days old. Sent to the laboratory as a suspected case of paratyphoid infection on 18/9/26. Diagnosis, probably bacillus coli infection. Some anæmic changes and enteritis present.

Numerous hand-reared calves on this farm had died from the combined effects of paratyphoid and enteritis, and no organisms, other than bacillus coli, could be isolated from the organs. Several attempts were made to obtain cultures from the circulating blood of calf X 1170, during the first ten days after its arrival at the laboratory, but always with negative result; repeated culturing of the fæces gave only bacillus coli. The blood of this calf did not agglutinate paratyphoid bacillus, and blood smears showed no parasites, and no anæmic changes. During the next four weeks the calf appeared to make a good recovery, coughing at feeding time decreased and finally disappeared, the action of the bowels became regular, and the fæces normal in colour and consistency. The calf fed well, and its condition became good, the only indication of persisting infection was that the temperature remained somewhat higher than normal.

On 18/10/26, when sixty-nine days old, calf X 1170 was given by stomach tube 20 c.c. of a 24-hour-old broth culture of calf paratyphoid bacilli, strain 419. The temperature of the calf rose to 105° on the morning of the fifth day, and 105.6° on the evening of the same day, and on this day a pure culture of paratyphoid bacilli was recovered from circulating blood taken from the jugular vein. Diarrhœa was a marked symptom from the seventh to ninth days . The temperature fell suddenly on the twelfth day after feeding and the calf died.

Post-mortem examination : condition fair, evidence of diarrhœa, acute enteritis, marked hyperæmia of both lungs. Blood smears : no parasites seen, and no anæmic changes present.

Cultures : paratyphoid bacilli in pure culture from the heart blood, and paratyphoid bacilli and bacillus coli from the organs.

The record of this calf is of interest since it shows that recovery from an attack of ordinary " white scour " confers no immunity whatever against paratyphoid infection.

Subcutaneous inoculation of cultures is a much less certain method of reproducing the infection. The majority of calves react slightly or not at all with this method of administration.

Infection by Contact with Artificially Induced Cases.

Infection by contact with artificially produced cases of the disease is by no means common, but does occasionally occur. The record of calf X 732 illustrates such a case.

Calf X 732.

Was born at the Laboratory Farm on 16/4/26. It was not in good condition when brought to the laboratory on 19/4/26. The placental membranes were retained for some days by the mother, and her blood was positive to the agglutination test for contagious abortion, although the calf was a full-term one. This calf was inoculated on 19/4/26 with 5 c.c.s of blood containing *P. bigeminum* and *Anaplasma marginale* (the so-called wild strain of redwater and gallsickness vaccine), and was placed in contact with six calves to which paratyphoid bacilli had been fed on 17/4/26. Nothing abnormal was noticed during the first two weeks of exposure, with the exception of occasional rises in evening temperature, and blood smears taken during the second week failed to show any evidence of infection with *P. bigeminum*. On the fourteenth and fifteenth days the calf showed diarrhœa coincident with a sharp rise in temperature to 104.8°. During this reaction the calf lost condition, but continued to feed a little. The fæces which were light yellow when the scouring first commenced, became dark brown in colour on the seventeenth day; the diarrhœa continued until death. On the two days prior to death the calf showed a lack of co-ordination of the movements of the hind limbs. Blood smears taken daily during this period showed no parasites and no anæmic changes other than slight anisocytosis, and on the sixteenth day a few polychromatic cells. The calf died during the night of the eighteenth-nineteenth days.

Post-mortem examination: condition poor, evidence of diarrhœa, muco-enteritis, liver congested, bile yellow in colour, lungs slightly hyperæmic; bronchial, mediastinal and mesenteric lymphatic glands slightly enlarged and œdematous. Some congestion of the mucous membrances of the bladder; urine normal in colour.

Blood smears: no parasites seen, slight anisocytosis.

Cultures: paratyphoid bacilli obtained in pure culture collected from the heart blood, spleen, liver and mesenteric glands.

Predisposing Conditions.

It is well recognised that certain conditions greatly favour the development of specific intestinal diseases; in addition to the most common factor, that of unhygienic surroundings, the more important of these predisposing conditions appear to be:—

(1) Youth;

(2) Prolonged periods of fasting, particularly in young animals:

(3) The administration of unsuitable food, leading to mild non-specific digestive disturbances;

(4) The co-existence of other debilitating diseases.

(1) *Youth.*

Fatal paratyphoid infection in Kenya appears to be confined mainly to calves between the ages of three weeks and three months old, although a few cases occur between three and four months.

The majority of deaths, however, occur during the second month of life. Only one definite case of paratyphoid infection in an adult ox due to the same organism as that isolated from calves has been observed by the writer in Kenya. This was the case of a three-year-old pure-bred shorthorn bull, which died after showing symptoms typical of paratyphoid infection. Examination of smears gave a negative result and a bacillus identical with that recovered from calves was obtained in pure culture from the organs and glands and almost in pure culture from inflamed portions of gut. This case occurred on what is perhaps the most heavily infected farm in the country. One other outbreak of paratyphoid infection in adult cattle has been observed in Kenya; in this instance quite an extensive outbreak occurred among dairy cows, but the organism responsible was an inosite fermenter of the paratyhoid *B. aertrycke* group.

(2) and (3) *Prolonged fasting and unsuitable feeding.*

It has been shown by Basredka and his collaborators that fasting prior to the administration of cultures to experimental animals considerably increases the chances of successfully infecting the animals with the causal organisms of specific intestinal diseases. Unpublished observations of Daubney and Galloway, with reference to the artificial infection of lambs and rabbits with *bacillus coli* and of rabbits with *salmonella*, confirm Besredka's findings. Mitchel (1925) has also shown that prolonged periods of fasting have considerable influence upon the incidence of paratyphoid infection of lambs in the United States of America. It is fully appreciated by stock-owners generally that unsuitable feeding of young stock will result in a succession of slight digestive derangements which will constitute an extremely favourable opportunity for infection by the causal organism of a specific intestinal disease.

Dairying in Kenya.

The principle of taking from the cow milk normally intended for the nourishment of the calf, reacts unfavourably upon the chances of survival of the calf unless other factors are introduced to reinstate the normal balance. This balance can usually be maintained because dairying cattle have been so improved that they produce milk far in excess of the normal requirements of the calf. It is also possible to use substitutes in the shape of meals and oils in place of a certain amount of

milk, and especially for the butter fat. In Kenya, however, the majority of cattle used for dairying are either low-grade animals of relatively poor milk-producing power or even ungraded stock. The practice here is to milk once or twice a day, leaving the strippings or perhaps one quarter of the udder for the calf if milking twice is practised; or if milking once, separating the calves from their mothers for roughly twelve hours before the milking period and allowing them to suck during the remaining twelve hours.

In one case the calves are fasted for almost twelve hours between each meal and in the other case a period of approximately 12 hours during which the calf is at liberty to feed alternates with another period of almost 12 hours' fast.

In experimental observations fasting for periods of 12 hours before the administration by the mouth of a culture, does not seem to have any appreciable effect since nearly all the animals, whether fasted or not, react to the infection; yet it is possible and even probable that prolonged periods of fasting do increase the chances of natural infection, and greedy feeding on the part of a calf after twelve hours' fasting does undoubtedly result in mild digestive disturbances which make the calf a readily susceptible subject for paratyphoid infection. Another disadvantage to this system of milking is that it necessitates the collection of the calves in a comparatively small pen at milking time, since low-grade cattle are commonly, though perhaps erroneously, reputed not to give milk unless the calf is present; and frequently also the penning of the calves during the night in an insanitary boma where there is every chance of spreading infection once an outbreak is started. In Kenya, paratyphoid infection does not seem to be a disease of hand-reared calves, although it must be conceded that there are few farms on which hand-rearing is practised, and therefore observations are limited. Farmers who practise the hand-rearing of calves suffer quite considerably from intestinal diseases among the calves, but in those cases that have been investigated, paratyphoid infection has not yet been diagnosed. The commonest infection in hand-reared calves in this country appears to be *bacillus coli* septicæmia resulting in pneumonia and enteritis, terminating in many cases fatally. The record of calf X 1170 given above is interesting in this respect.

Climatic Conditions.

It is possible that climatic conditions may exercise an influence on the incidence of paratyphoid infection. Some of the worst infected farms in Kenya are at altitudes considerably over 9,000 feet, and in districts where there is excessive rainfall and lack of sun.

The following record compares the monthly death-rate amongst sucking calves with the monthly rainfall on a heavily infected farm, during the year 1925 and part of 1926. This farm is at an altitude of 11,000 feet, and is probably the most heavily infected farm in the country. There appears to be a fairly close correlation between the heaviness of the rainfall and the number of deaths occurring. The rainfall is at its heaviest in May, June, July and August, and this is equally the most fatal period for calves. The sudden increase in rainfall to 8.48 inches in November appears to be reflected in the deaths taking place in the next month. During January, February and March, 1926, a large proportion of the calves on the farm were vaccinated with a killed vaccine, but it is extremely doubtful, in view of our later experience on this farm, whether any credit should be given to the vaccine for the fall in the death-rate during these months. It is much more likely that the decrease is due to the more favourable weather conditions.

Month	Total number of unweaned calves on farm	Total Deaths	Total rainfall in inches
	1925.		
January ...	314	18	4.90
February ...	390	10	0.54
March	400	22	4.23
April	455	17	0.62
May	437	28	8.25
June	443	56	7.44
July	469	57	8.63
August	449	60	10.03
September ...	462	28	1.32
October ...	434	38	1.63
November ...	378	28	8.48
December ...	382	40	3.03
	1926.		
January ...	375	22	0.86
February ...	372	16	2.29
March	387	21	1.31

(4) *The co-existence of tick-borne diseases.*

One factor which must be given consideration in assessing the influence of pre-disposing conditions in the almost universal infection of calves with certain tick-borne diseases. In Kenya

the great majority of calves acquire infection with *P. bigeminum*, *anaplasma marginale*, *spironema theileri*, and *piroplasma mutans*, at a very early date, probably as a result of bites of ticks during the first few days of life. Under normal conditions the reaction of calves to these infections is usually so slight as to escape observation. This is certainly true of calves other than pure-bred animals or calves bred from imported stock. In the case of the latter the reaction to *anaplasma marginale*, which occurs generally during the third month of life, may be sufficiently great to necessitate a certain amount of treatment and nursing. The reaction to *piroplasma bigeminum* is hardly noticeable in any young calves under normal conditions, nor is that of *piroplasma mutans*. *Spironema theileri* produces a slight thermal reaction, as a rule quite unaccompanied by symptoms. A certain number of cases of paratyphoid infection have been observed in which the infection has been complicated in the later stages by a reaction to natural infection with *anaplasma marginale*. In the case of calf X 414 mentioned in the annual report for 1925, the reaction to *anaplasma marginale* commenced nineteen days after the calf had first been noticed sick and the calf died five days after the commencement of the *anaplasma marginale* reaction.

The record of calf X 374 is also of interest in this connection. Calf X 374 arrived at the laboratory on 15/12/25. The blood of this calf agglutinated the paratyphoid organism in a dilution 1 : 2,000 on 16/12/25, indicating that the calf had then been sick for some little while. At the time of admission to the laboratory, this calf showed a fairly heavy infection with *anaplasma centrale*, probably derived from vaccination with the laboratory anaplasmosis vaccine. During the following three weeks the anaplasmosis reaction receded and the anæmic changes disappeared. During the third week a mild thermal reaction was noticed and the blood became heavily infected with *piroplasma mutans*. During the reaction to *piroplasma mutans* anæmic changes again became evident, and on two occasions a few *piroplasma bigeminum* were seen in blood smears. The reaction to *piroplasma mutans* receded during the fifth week and from the commencement of the sixth week to the time of death there were no anæmic changes and small piroplasmas were very rare in blood smears. In this instance the successive infections with *anaplasma centrale* and *piroplasma mutans*, accompanied by a slight recurrence of *piroplasma bigeminum* infection, did not appear to affect in any way the ultimate course of the disease. It has been our practice when investigating paratyphoid infection to request owners to furnish blood smears of sick calves at the time of the onset of illness and again at death, and it has not been uncommon to find animals giving a positive diagnosis to paratyphoid and showing at the same time an infection with *anaplasma marginale*, frequently accompanied by apparently severe anæmic changes. The

presence of anisocytosis, basophilia and numerous polychromatic cells at the time of death, together with an *anaplasma* infection, has been regarded as strong evidence in favour of the view that *anaplasma marginale* was the cause of death. It is possible, however, that in an examination of blood smears from young calves too much importance can be attached to the appearance of anæmic changes which might reasonably be regarded as severe in adult animals. It is reasonable to consider all the changes mentioned as evidences of a too rapid regeneration of blood cells stimulated by the destruction of red cells in the circulation. It is also well known that calves during the first fortnight of life may show all these changes in blood smears merely as a result of the normal functioning of their hæmapoietic system. It might reasonably be supposed that slight stimulation only is required to bring about such anæmic changes as appear in calves affected with anaplasmosis. It is also certain that the anæmic changes in these cases can and do disappear within the course of twenty-four hours. An attempt was made at the laboratory to assess the affects of redwater and anaplasmosis infection when combined with paratyphoid infection.

Six calves, varying in age from 23 days to 126 days were inoculated, three with *anaplasma marginale* and redwater and three with *anaplasma centrale* and redwater. The calves were also fed with a small quantity of culture of paratyphoid bacilli. All the calves gave a thermal reaction to the paratyphoid feeding, one inoculated with *anaplasma centrale* reacted markedly to the inoculation, but although four others showed *anaplasma* as a result of inoculation, none gave a marked reaction to the inoculation; all the calves recovered. These calves were fed in the usual manner.

Six other calves varying in age from 44 days to 103 days were inoculated, three with *anaplasma centrale* and redwater, and three with *anaplasma marginale* and redwater. All were fed with a small quantity of culture of paratyphoid. The mothers were milked as though for cream production and the calves received only the strippings. All the calves reacted to the paratyphoid feeding. One gave a thermal reaction also to *anaplasma centrale*. One calf aged 60 days gave a slight reaction to the inoculation of *piroplasma bigeminum*, and one calf, No. 524, died 12 days after the commencement of the reaction to *anaplasma marginale*, and 5 days after a second feeding of paratyphoid culture given at the height of the reaction to *anaplasma marginale*. At the time of death *anaplasma marginale* were present in 0.85 per cent. of red cells, *piroplasma bigeminum* in 0·08 per cent. of the cells and *piroplasma mutans* in 0.04 per cent. of the cells. There were no anæmic changes. Paratyphoid bacilli were obtained in pure culture from the organs of X 524.

It is possible that the two infections are jointly responsible for the death of calf X 524, although the characteristic temperature curve with marked morning remissions following the rise during the second week suggests that the chief factor concerned is paratyphoid infection. It is also significant that at the time of death infection with protozoan organisms was extremely light and there were no anæmic changes present.

Altogether during the course of these experiments, which it is unnecessary to record in detail, 25 calves were inoculated with redwater and anaplasmosis, 12 with *anaplasma centrale*, and 13 with *anaplasma marginale*. Of these calves 3 died, No. X 524 to which reference has already been made, and Nos. X 815 and X 416. No. X 815 was inoculated with *anaplasma marginale* alone and was placed in contact with paratyphoid fed calves. This calf died nine weeks after inoculation, having shown no marked reaction either to redwater or anaplasmosis. The cause of death was apparently peritonitis, and did not seem in any way to be connected with the inoculation. Examination of blood smears at death gave a negative result. The third calf X 416, died 33 days after inoculation with *anaplasma marginale*. On the 31st day the temperature rose from 100.4° in the morning to 105.4° in the evening. *Anaplasma marginale* were fairly frequent in the blood smears. The temperature dropped on the following morning to 100.8° and rose in the evening to 102°. The temperature then became sub-normal and the animal died. *Post mortem;* the liver appeared normal although there was slight jaundice of the tissues. The lungs were œdematous and contained small hæmorrhages. The urine was blood-red in colour. Examination of smears showed that *anaplasma marginale* was present but not very frequent, *piroplasma bigeminum* very rare, anisocytosis, basophilia and polychromasia. Calf X 416 died apparently as the result of a recurrence of redwater during the *anaplasma marginale* reaction. Calf X 416 at the time of death was 115 days old.

To summarise.—Of 25 animals inoculated with anaplasmosis, and of which some also were fed with paratyphoid, two animals died showing infection with *anaplasma*. One of these animals was also infected with paratyphoid, but the remaining animal died apparently from a recurrence of redwater. Of a total of twelve of the same animals to which paratyphoid cultures were fed, one died of paratyphoid during the anaplasmosis reaction. The average age of the calves to which paratyphoid bacilli were fed was 76 days, which means that these calves had passed the most susceptible period to artificial paratyphoid infection.

These observations do not assist one to form conclusions as to the relative importance of paratyphoid infection and anaplasmosis as the cause of death. A series of observations carried out on smears and specimens do, however, furnish more satisfactory evidence. It has been arranged with the proprietors of a farm to furnish specimens of gut, gland, and liver from all the calves dying in one of the herds during a certain period.

The details of specimens and smears received are charted in figures. The curve showing the total number of specimens examined during each month of life may be taken as fairly accurately representative of the number of deaths occurring during the period under review. The blood smears shown in figs. 1 and 2 were, however, taken at the commencement of the

FIG. 1

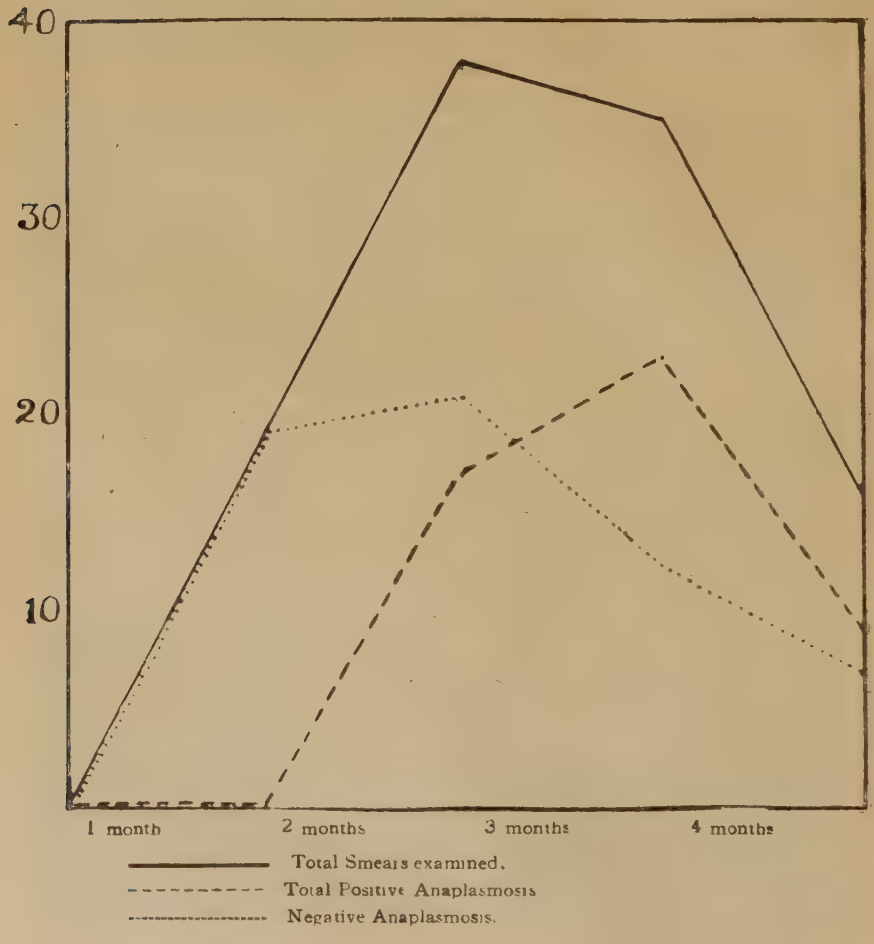
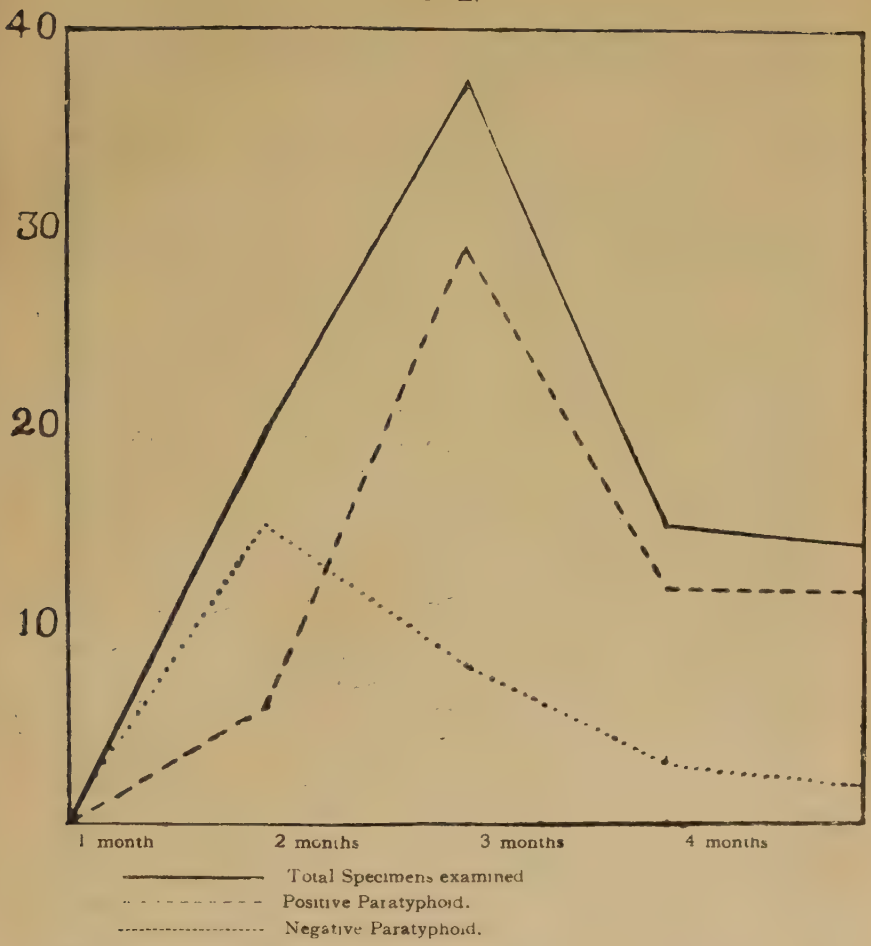


FIG 2.



illness and at death if the illness terminated fatally, although two such smears from one animal are counted for the purposes of this record as one. It will be seen that the peak of the deaths occurs during the second month of life; and indeed, the owner of this farm had already stated that 70 per cent. of the total of deaths occur between the ages of one and two months. The number of deaths declines very rapidly during the third month of life, although judging by the smears received the number of cases of sickness are not noticeably decreased during this month. There are certain salient facts that emerge from an examination of the charts. It is evident that the greatest number of cases of paratyphoid occurred during the month in which the greatest number of deaths occurred, and that during that month approximately 80 per cent. of the specimens from dead animals gave a positive diagnosis of partyphoid. During the same period only 44 per cent. of the specimens examined showed anaplasmosis. The *anaplasma* infection reached its

maximum during the third month, when approximately 66 per cent. of the smears examined were positive for *anaplasma* infection. During this month, however, the death rate appears to have declined by approximately 60 per cent. Another fact of importance not shown on these charts is that, of the specimens included, there were thirteen positive cases of paratyphoid occurring between the 21st and 38th day of life, while the first positive anaplasmosis smears are not recorded until the 42nd day. The information gathered by this record shows also that a certain number of deaths occur during the first four weeks of life, chiefly as a result of intestinal disturbances, due variously to infections with *bacillus coli*, *bacillus proteus*, and *bacillus pyocyanous*, that the paratyphoid infections do not commence until about the 21st day of life, and reach their peak during the second month. *Anaplasma* infection on the other hand does not commence until the 42nd day and reaches its peak of infection during the third month, when the deaths are rapidly declining. One might conclude that while the coexistence of *anaplasma* infection may assist in producing a fatal termination to a paratyphoid infection yet the majority of losses from paratyphoid are incurred independently of *anaplasma* infection.

Viljoen and Martinaglia state that in South Africa the mortality is confined to farms where no effective measures for the eradication of ticks have been taken, and that although paratyphoid infection may occur in the absence of this important factor, in practice it seems to be a complication of protozoan diseases. They suggest that the disease can be controlled very largely by practising sound farming measures such as regular dipping of all cattle, proper feeding and management of calves. In Kenya it would appear that in this connection less importance can be attached to infection by tick-borne diseases than is the case in South Africa. It might also be remarked that the organism obtained from outbreaks in Kenya shows certain differences from the ordinary Gaertner strains such as those isolated in South Africa and in Europe generally. Other points of interest in connection with the relationship of paratyphoid infection to protozoan diseases are :—

(1) The entire absence of losses from anaplasmosis on farms uninfected with paratyphoid.

(2) The prevalence of paratyphoid infection in the dairying districts of Germany, Switzerland, and Denmark, where hæmatozoan infections are comparatively unimportant.

(3) The well-recognised tolerance of young animals to infection with blood protozoa of the *piroplasma* group.

Preventive Treatment.

As a preventive prophylactic measure the laboratory at first issued a killed vaccine of the bacterin type, containing several strains of calf paratyphoid bacilli. According to the reports of

owners this vaccine was quite successful in curtailing outbreaks of the disease on small, lightly infected farms; it failed completely, however, to affect the incidence of infection on the more heavily infected and larger premises. In view of this failure a living vaccine, to which a small amount of preservative had been added, was next issued. This vaccine was injected simultaneously at birth or as soon after birth as possible, and it was found that in a number of calves a pronounced reaction occurred about the tenth day after vaccination. In a few cases the calves died as a result of the vaccine reaction, but on the whole recovery was the rule. It was decided, partly as a result of the violent reaction following the vaccinatoin, to issue a hyperimmune serum for treatment of vaccine reactions and natural infections. The practice now is to vaccinate calves with the living vaccine, and to administer a dose of serum to any calf that may show symptoms some ten days later as a result of the vaccination. A further dose of serum is given if the calf exhibits any sign of having contracted a natural infection between the ages of one and three months. On some farms this routine has been remarkably successful, but on others its practice has been attended with only a moderate degree of success. Under experimental conditions, when calves are infected by the feeding of cultures, the simultaneous administration of serum successfully inhibits the usual temperature reaction resulting from feeding of culture. In a few cases a mild thermal reaction is noticed, but in no case where serum has been given has it been possible to recover cultures of the organism from the circulating blood during the temperature reaction.

A subsequent test of immunity, carried out on these calves some 65 to 70 days after the simultaneous vaccination, indicates that the administration of serum has not interfered with the development of the active immunity which should result normally from the feeding. It is noticeable, however, that the reaction to the test feeding of culture is slightly more marked in animals that have received serum than in those that have been vaccinated by the administration of living culture alone.

Any attempt to control the disease by the use of vaccines or sera must be accompanied by a serious effort to improve the hygienic conditions of calf-rearing. Where possible calf bomas should be moved at frequent intervals to prevent the ground becoming foul, and general measures should be instituted for the improvement of conditions in the milking boma. Calves should not be crowded, and if practicable, should be kept in fairly small herds; on a heavily infected farm individual herds might, with advantage, consist of twenty-five calves as a maximum. This advice has a sound experimental basis, and the decrease in the incidence of the disease, resulting from the suggested measures, would in all probability amply repay the farmer for the additional trouble entailed. Further, the closest

supervision should be exercised over the actual milking in order that calves may obtain, as nearly as possible, a definite and regular quantity of milk at each feeding.

(F) STREPTOTHRICOSIS.

OR "UASIN GISHU SKIN DISEASE."

Enquiries have been made by stockowners during the year for information concerning this disease. A number of cases have been recorded in cattle, and more recently there have been outbreaks amongst sheep. Several strains of the organism have been isolated both from cattle and sheep, but their classification is not yet complete. Attempts to reproduce the disease in cattle by the application of pure cultures to the skin after scarification, have so far failed. It has been suggested that animals must be in bad condition to become susceptible to this infection.

Treatment.—Practical experience indicates that the spread of the disease can be controlled by dipping in arsenical fluids, and that individual cases will, if not too far advanced, generally recover under this treatment. It is possible that lime and sulphur dippings might prove valuable for the treatment of streptothricosis, and the relationships of the organisms suggest that local applications of iodine or of oil and sulphur might also prove of value.

(2) DISEASES OF SHEEP.

(A) OBSERVATIONS ON A LUNG AFFECTION OF LAMBS AND SHEEP.

On various occasions during 1925 the attention of this institution has been directed towards mortality in lambs and adult sheep, in which the *post-mortem* lesions found were principally those of a pneumonia with pleurisy.

Owners were requested to collect and forward to the laboratory, specimens from sick or dead animals, and on examination lesions were found which suggested a specific infection.

The attention of this laboratory was particularly directed towards mortality in lambs from lung affection, in the Laikipia district, at the instance of the Chairman of the Sheep Branch of the Mount Kenya Farmers' Association, in December, 1925, and Dr. S. H. Whitworth, Veterinary Research Officer, was immediately detailed to investigate *in loco*, and to collect material.

The result of this preliminary investigation showed that an affection occurs in sheep, and particularly in lambs, on a number of farms in the Laikipia district, and which is responsible for serious losses. The affection was found to occur as an epizootic in some instances, and mortalities of over 50 per cent. were reported in individual flocks. Owners reported the condition as occurring in both May and October lambs, with probably greater prevalence after the October lambing.

The opinion of owners was, generally, that the disease appeared with more certainty and the mortality was heavier, during the very dry periods, and that while it occurred more frequently in lambs, it had also been seen as an epizootic in adult sheep. It was usual, however, to see sporadic cases in adult sheep. Owners considered that the condition as seen in lambs was identical with that in adult sheep.

Grade lambs of all breeds appeared to be most susceptible, although cases were reported in native lambs and sheep.

It was found that two sheep owners in the Laikipia area were experiencing a very heavy mortality in lambs, with practically no mortality in adult sheep. Grazing at the time was good, although very dry. The sheep and lambs were herded in thorn bomas, which were continually being moved to fresh ground. No attempt was made to isolate affected lambs, since in many instances such animals could not be identified as no definite symptoms were observed.

During the early part of 1926 the disease continued on these two farms, and at the same time mortality was reported from various farms in the Nanyuki and Laikipia districts.

Symptoms of the disease.

Frequently no definite outward symptoms were observed, lambs which appeared apparently healthy one day being found dead in the boma by the herd the following morning. Such lambs, when *post-mortemed*, showed the typical lesions in the chest cavity.

In the majority of cases, however, an affected lamb was noticed to be dull and lagging behind the flock. Coughing was noticed, especially after excercise. The temperature in an acute case was found to be elevated—up to 107° Fahr.

On one farm a heavy mortality was observed in lambs in which the first symptoms seen were conjunctivitis, followed after about twenty-four hours by a watery discharge from the nose, and redness and swelling of the mucous membrane of the lips. After about three days symptoms of lung affection, coughing, etc., were observed, and on *post-mortem* examination typical lesions in the chest cavity were found. Many of these cases became temporarily blind, and some remained permanently so.

Similar eye, nose, and mouth lesions were observed on other farms, together with the lung condition, but not to the same extent as in the particular case cited above.

Lung lesions were not seen on *post-mortem* examination in all these cases when slaughtered, but were seen on *post-mortem* of the majority of dead lambs.

In some instances a distinct reddening of the skin of the body was seen. This was particularly noticeable inside the forearms or inside the thighs.

In lambs which had apparently recovered from the acute conditions, unthriftiness and persistent coughing was noticed. On *post-mortem* examination typical lesions of the disease were found.

Post-mortem lesions.

In a typical case the only lesions found on *post-mortem* examination are those in the chest cavity.

It must be pointed out, however, that some lambs which were thought to be lung cases by their visible dullness and loss of condition, showed on *post-mortem* examination no lesions whatever. Similar observations were made in some of the lambs showing eye, nose and mouth lesions, and reddening of the skin.

In typical acute cases the lesions consisted of a pleuro-pneumonia affecting one or both sides of the chest cavity. In the majority of cases only a part of one or both lungs was affected, and this usually towards the anterior end of the lung.

The affected part of the lung is solid and contains abscesses varying in size from a pea to that of an orange. Round these abscesses are seen areas of solidified lung, which on section is greyish to red in colour, and on the cut surface can be seen numerous greyish spots about a pin's head in size.

The pus in the abscesses is yellowish in colour, and sometimes blood-tinged, and has an offensive odour, especially in early cases.

The chest cavity on the affected side contains varying amounts of a sero-fibrinous purulent fluid, yellowish in colour, with a foul odour, and sometimes blood-tinged, especially in early cases.

In early cases the whole surface of the lung is roughened by yellowish exudate, which may cause some attachment of the lung to the chest wall. In other chronic cases the lung is seen to be attached to the ribs by tough fibrous bands, only over the area corresponding to the affected part of the lung.

In lambs that have been sick for some time before death, or in chronic cases when slaughtered, little or no fluid is found in the chest cavity, and if abscesses are present in the lung, the pus contained in them is greenish-yellow in colour and of the consistence of soft cheese. In some old cases only a few small abscesses are present in the affected part of the lung, which appears collapsed, is solid, red in colour, and contains greyish spots on the cut surface.

The lesions in the lungs of chronic cases appear to be circumscribed, *i.e.*, the affected part of the lung is bordered by apparently normal lung tissue. In early acute cases, in addition to the changes in the pleura covering the lung, there may be some hyperæmia and œdema of the remaining part of the lung.

In acute cases the lymphatic glands of the chest cavity appear swollen and very moist on section; while in chronic cases they are frequently observed to have undergone degenerative changes, the glands being merely a mass of yellowish-green thick pus in a fibrous capsule.

In some lambs slaughtered as suspected lung cases, the liver was seen to contain many abscesses containing yellowish pus. It is not known as yet whether these changes are connected with the lung affection.

Experimental Investigations.

(1) *In the Laikipia district.*

It was suggested at first, by some owners and others, that the disease was identical with bluetongue, and others again considered it to be a form of sheep-pox.

With regard to bluetongue, no typical symptoms of bluetongue were observed in any of the lambs or sheep examined. Moreover, the disease appeared during seasons when bluetongue infection is usually absent. Inoculation experiments were conducted on three farms to determine whether blood from a typical case produced a bluetongue reaction, on inoculation into susceptible lambs.

In all cases negative results were obtained. Further, no reaction whatever resulted from the subcutaneous or intravenous inoculation of blood from a typical case into healthy lambs.

With regard to sheep-pox. Many lambs in various lung-infected and non-infected flocks were examined for the presence of the characteristic skin lesions of sheep-pox, but with negative results. Moreover, the lung lesions seen, on *post-mortem* examination, did not correspond with those seen in typical cases of lung lesions of sheep-pox.

Sub-inoculations were made in the field, *with pus* from the chest cavity, and pus from the lungs, of typical lung cases immediately after slaughter.

Lambs susceptible to sheep-pox were inoculated subcutaneously (*i.e.*, into the skin of the thigh) while in others scarified areas of the skin inside the thigh were rubbed with pus. In no instance did sheep-pox infection result.

In the case of cutaneous inoculation of pus, severe local reactions were observed in two cases, the inoculated limb becoming swollen, very painful, and the animal scarcely able to move. Death occurred in one case with lesions of a septicæmia being observed on *post-mortem* examination.

The subcutaneous inoculation of pus from the chest cavity into a healthy lamb resulted in one instance in a severe swelling of the whole limb with eventual recovery, and in another in death of the inoculated lamb, from septicæmia after five days.

Blood smears from affected lambs were examined, with negative results.

At the same time experiments were conducted in the field to see whether infected lambs easily transmitted infection to healthy lambs in-contact. No positive results were obtained.

From the preliminary field investigations the following tentative conclusions were made :—

(1) That the disease is specific, and is not identical with either bluetongue or sheep-pox infection ;

(2) That the affected lungs and chest cavity of typical cases contained organisms which were pathogenic for sheep.

(2) *At the Laboratory.*

Several typically affected lambs were brought to the laboratory in December, 1925.

In the first instance they were all tested on their immunity or otherwise to bluetongue and to sheep-pox infections. They were found to be susceptible to both diseases. These results confirmed the field experience that the disease as seen is not identical with either bluetongue or sheep-pox.

Attention was then directed towards bacteriological investigation and cultural examination of cases brought to the laboratory during 1926 has been carried out.

Smears made from the chest cavity and lungs of cases showed the presence of numerous types of organisms, and in most cases several types of organisms were isolated by culture. The presence of a small gram-negative bacillus was always observed, and this organism was obtained from the mesenteric glands in pure culture. In view of the fact that this organism was consistently found in typical lung cases, experiments were conducted to determine its pathogenicity.

Experimental Inoculation.

9 c.c. of a 24-hour-old broth culture injected intravenously into healthy sheep resulted in death in all cases in about 16 hours, with lesions of a generalized septicæmia on *post-mortem*. The organism could be isolated from the blood and parenchymatous organs of the body in all cases. This experiment merely showed that the organism isolated was pathogenic for sheep.

Several strains of this organism were isolated from different lambs, and intravenous inoculations of young lambs with 2 c.c doses of 24-hour-old broth cultures were made. In some instances death occurred as quickly in these cases as in those of older sheep inoculated with larger doses. In all other cases inoculated lambs showed an immediate rise of temperature,

with symptoms of dullness, and on or about the third day some stiffness in movement. Later this developed as a definite lameness in one or more limbs with evidence of definite swelling of some of the joints.

The affected joints on further examination were found to be swollen and very painful on pressure. Some of the inoculated lambs showed such severe joint lesions that they were unable to rise, and eventually died. Others gradually recovered.

In the case of two lambs inoculated with 2 c.c. of 24-hour-old broth culture, and which lambs died after seven days, pathological changes in the chest cavity were observed. In one case acute exudative pleurisy with hyperæmia of the lung was present. In the other there was acute pleurisy with much fluid in the chest cavity, and the anterior part of the right lung was solid, and on section showed small abscesses containing yellow pus. In this latter case the lesions produced were identical with those seen in early cases of natural infection with lung disease.

In all cases showing joint lesions, and in those showing pulmonary lesions, the infected organism could be recovered by culture. It is to be noted, however, that when an animal was allowed to live for several days after inoculation, several types of organisms could be recovered. These organisms no doubt invaded the affected areas after the particular injected organism produced lesions.

Subcutaneous inoculation of one lamb inside the thigh produced a temperature reaction with swelling of the limb, and acute lameness. The lamb eventually recovered.

Experiments were conducted to determine whether or not the organism produced any reaction in healthy lambs, when given in broth culture *by the mouth*, and inoculated *on the eye-ball*, and injected *into the trachea*. In all cases negative results were obtained.

When a culture of the organism was injected into the lung direct, a high temperature reaction, with marked dullness and symptoms of pneumonia resulted, and the sheep died on the third day with lesions of pneumonia and acute exudative pleurisy on *post-mortem*.

Healthy lambs and sheep placed in contact with affected lambs did not become infected.

Attempts were made to isolate an organism by filtering lung and chest cavity fluid from a typical case, but the results were negative.

Summary of the Laboratory Experiments.

(1) The isolated organism is pathogenic for sheep and lambs.

(2) By intravenous inoculation its predilection seat is in the joints.

(3) By intravenous inoculation, in addition to joint lesions, acute lesions in the chest cavity may be produced.

(4) It has not been possible to produce infection in healthy lambs by oral, intratracheal, or conjunctival administration of the organism.

(5) It has not been possible to infect healthy lambs by placing them in contact with lambs suffering from lung affection.

(6) A filter-passing organism has not been obtained from filtered diseased lung and chest cavity fluid.

Experimental Field Inoculations.

Since the organism as isolated was proved pathogenic for sheep, and as it was isolated from the lungs of typical cases of naturally infected lambs, it was decided to issue for field inoculation an experimental vaccine made from culture of the organism.

During 1926, 31,043 doses of this vaccine were issued to settlers for experimental use.

The following types of vaccine have been issued :—

Vaccine No. 1.—Dilute suspension of the killed organism saline solution;

Vaccine No. 2.—Heavy suspension of the killed organism in saline solution;

Vaccine No. 3.—Filtrate of a broth culture of the organism;

Vaccine No. 4.—Killed broth culture of the organism.

Owners have been given to understand that the vaccine should be inoculated as soon after birth as possible, with doses of 5 c.c. each, with an interval of ten days between each inoculation.

Owners were requested to furnish us with details of their observation on the use of these vaccines in their flocks, and in most instances these details have been supplied.

In some instances the vaccine does not appear to have been of value, while in many reports owners have given us as their opinions that the vaccine prevented infection and mortality in inoculated lambs.

During the latter part of 1926 the mortality from lung disease of lambs, as an epidemic, does not appear to have been very great in the Laikipia district, and therefore it is not possible to obtain definite evidence as to the value of the vaccine.

Sporadic cases in lambs and adult sheep are still reported, and cases of old " lungers " have been seen on *post-mortem* examination.

The majority of the vaccine issued has been those indicated above as Nos. 1 and 2. The technique of the preparation of vaccine from broth is very difficult, and we are not yet in receipt of information indicating the value of the vaccine prepared from broth cultures (*i.e.*, Vaccines Nos. 3 and 4 above).

It is to be noted that no attempt has been made as yet to prepare a living vaccine, in view of the experimental evidence obtained at the laboratory, as to the virulence of the organism when inoculated subcutaneously.

It has not been proved what is the actual method of infection with lung disease.

There is no doubt from observations made that lambs may become what might be termed " lungers," in that they have old lesions of lung infection for some time after apparent recovery. It is possible that such cases are carriers of infection.

It has also been observed that lambs may completely recover from the affection, in that no lung lesions are present on *post-morten* examination of lambs which obviously showed symptoms of lung affection some months previously.

It has been considered that the disease is more prevalent in the hot, dry and dusty weather, and whether the entrance of dust into the lung causing small injuries is a predisposing factor has yet to be proved.

Sheep and lambs in this Colony appear to be very susceptible to pyogenic infection, *i.e.*, infection with organisms which produce pus. Acute lameness in lambs with pus formation in the joints is frequently seen, and cases have been observed in lambs where abscesses have been produced in the subcutaneous tissues of the body as a result of the entrance through the skin of the seeds and spikelets of a common fodder grass (*themada triandra*) in this Colony. Investigations are proceeding to determine whether an organism is present in such cases, and if so whether it is identical with that isolated from lung cases.

The inability to produce as yet, experimentally, typical cases of the disease at the laboratory, and the inability to obtain typical acute cases from the field, are factors which prohibit the progress of this research.

Experimental work and the issue of experimental vaccines is being continued.

So far two visits have been made to the Laikipia area in connection with these investigations. During the last visit in December, 1926, owners reported, as requested, the existence of the disease, but no suitable cases were found. On the

contrary the cause of the mortality was found to be due to worm infestation, particularly wireworms, hookworms (Nanyuki) and trichostrongyles. Isolated cases of old "lungers" were found.

(B) PARASITIC WORMS.

The survey of species of helminths parasitic in domesticated animals has been continued during 1926, by Mr. R. Daubney, A.C.V.R.O., who reports as follows thereon :—

There are certain additional records to be made. Three new species, all belonging to the round-worms sub-family *Trichostrongylidæ*, have been collected, and a full description will be furnished in one of the technical periodicals. So far, there have been no losses directly attributable to infestation with any of these new species. The incidence of losses due to heavy infestation of the various species has also been carefully noted with the view of issuing to farmers advice on preventive measures and treatment. Three species have been mainly concerned in the causation of losses in sheep during the year; these are in approximate order of importance : the hookworm, the wireworm, and small trichostrongyles.

There have been extensive outbreaks of hookworm disease, chiefly among weaners of from five months to one year old. May lambs appear to have been much more heavily infected than lambs born towards the end of the year. The reason for the heavier incidence of infection on lambs born in May appears to lie in the suitability of weather conditions to rapid parasitic development during and after the short rains, when these lambs are from four to eight months old, that is to say at the most susceptible age. Wireworm infestation has been diagnosed as the cause of death in sheep of all ages, but more frequently in weaners and yearlings. Here again the particularly dangerous periods are shortly after the rains. A number of outbreaks of gastro-enteritis among lambs and yearlings have been caused by heavy infection with small trichostrongyles chiefly *Trichostrongylus colubriformis*. The symptoms of heavy infestation with this species resemble in general those of other round-worm infestation, but the anæmia of the visible mucous membranes is hardly so marked as in hookworm disease.

Investigations are in progress with reference to various points in the life-histories of these species, in particular on the subject of their survival under natural conditions. The rough outlines of a typical life-history were indicated in the Annual Report for 1925, and it is unnecessary to recapitulate.

During 1926 the reactions of the infective larvæ of the sheep-hookworm to various physical stimuli have been studied; a more detailed report will be issued later, when these investigations are complete. Certain characteristics of the larvæ may, however, be mentioned at this juncture.

These larvæ are extremely sensitive to the influence of light and will move definitely in the direction from which the rays of light are transmitted. They also react promptly to any application of heat, moving rapidly towards a source of heat, such as a hot needle held beneath a slide upon which the larvæ are placed in a drop of water. A group of larvæ will collect on the slide above the point of the needle, with heads all turned towards the needle point. Warmth induces active movement, but the optimum temperature for larvæ is fairly high and they remain more or less inactive at temperatures between 20° and 25° centigrade. This question of the optimum temperature for activity is one of considerable importance on the practical side, for activity at normal outdoor temperatures implies a rapid expenditure of energy, leading to consumption of the food granules stored in the intestine of the mature larvæ, and to subsequent death from starvation. Larvæ kept in the laboratory at an even room temperature, in vessels containing water, display little or no activity, and may survive for several months or even for periods in excess of a year. It has recently been shown, however, in the case of the larvæ hookworm of man, that the length of life under natural conditions is not comparable with that under laboratory conditions.

Taking advantage of certain characteristics of mature larvæ of the hookworm of man, Baermann in Java constructed an apparatus which enabled him to recover with a high degree of certainty almost all the living larvæ from samples of soil. Baermann's apparatus has since been used to determine the average life of the larvæ of human hookworm under tropical conditions.

An American commission found that in the West Indies heavily infected soil automatically became sterilised, so far as hookworm larvæ were concerned, in a period of about seven to eight weeks. The infective larvæ died quite largely from the effects of starvation, due to rapid consumption of the reserve food material to furnish the energy used in their continual migratory movements. Unfortunately the particular character of the human hookworm larvæ which is utilised in Baermann's apparatus is not shared by the larvæ of the sheep-hookworm. Had it been possible to isolate the larvæ of sheep-hookworms in this manner, the carrying out of accurate observations as to the length of the life of the larvæ would have been a comparatively simple matter. As it is, the isolation of sheep-hookworm larvæ from soil remains an extremely difficult and tedious process. Some observations have, however, been made upon the survival of these larvæ in cultures. Cultures are made by mixing animal charcoal with sheep's fæces that have been previously sterilised by heat. Mature larvæ are present in these cultures after five days' development at room temperature. By noting the relative numbers of mature larvæ that can be obtained from similar cultures at varying intervals after preparation, some idea can be obtained as to the length

of life of most of the larvæ. Even at room temperature, which remains fairly constant, there is a quite rapid consumption of the food reserves of the larvæ. Larvæ six or seven weeks old retain few food granules in the cells of the intestinal wall; whereas in young larvæ up to a fortnight or so, the structure of the intestinal wall is completely obscured by the heavy mass of food granules. There is a very evident loss of life in cultures over two months old, and at times it is difficult to recover even single larvæ from such cultures; although similar cultures at the age of two or three weeks may have yielded thousands of mature larvæ. It is probable, therefore, that the length of life of larvæ of the sheep-hookworm is not appreciably greater than that of hookworm larvæ of man. This means that under temperate or sub-tropical conditions of climate the life of the majority of larvæ will probably not exceed three months as a maximum.

More detailed observations are now being carried out, and the results will be communicated when the observations are completed.

Another factor in the survival of larvæ is the resistance they possess to drying. The resistance to desiccation of the larvæ of some of the species of strongylus parasitic in equines is extremely high, and quite considerable powers of resistance are also manifested by the larvæ of other species such as those of the sheep lung-worm, *dictyocaulus filaria.*

The infective larvæ of the sheep-hookworm are unable to resist the shortest period of desiccation. Once the moisture surrounding larvae has been allowed to dry completely, even for two or three minutes, the larvæ are incapable of reviving. It will be observed that in this characteristic we have an additional factor operating heavily against the survival of larvæ during protracted dry weather.

Mode of Infection.

The ability of these larvæ to penetrate unbroken skin has been tested experimentally, and in each case no evidence of penetration was obtained. Most of the larvæ placed upon the skin could be recovered from the surface of the skin after periods in excess of those usually required for skin penetration. The larvæ when placed upon the skin did not cast their sheaths, as do commonly those larvæ which are known as skin penetrators. It is probable therefore that the sole portal of infection is the mouth, but having once reached the gut the evidence indicates that the larvæ migrate from the gut to the liver and lungs, returning by way of the bronchi to the throat, where they are again swallowed and this time reach maturity in the small intestine.

It will be understood that preventive measures to be successful can only be based upon an accurate knowledge of the bionomics of the larvæ under conditions obtaining in this

country. It is hoped shortly to issue a bulletin, incorporating practical suggestions based upon the knowledge obtained in the course of these observations and adapted to existing conditions of farming.

Anthelminthic treatment.

It will be evident that, owing to the short life of the infective larvæ, infection will spontaneously and rapidly disappear from a pasture if the introduction of fresh infection by deposition of ova is discontinued. The removal of infected animals from the pasture is the most rapid and certain method by which this steady infection of land can be terminated; but it will be equally obvious that the application of any successful anthelminthic treatment of infected animals must also rank highly as a preventive measure. The anthelminthic properties of a number of compounds have been investigated during the present year, more particularly with reference to the treatment of the parasites of sheep. These experiments have confirmed the general belief in the efficacy of the wireworm remedy as an anthelminthic against wireworm. Unfortunately the wireworm remedy is only slightly efficacious against hookworms. Of a number of compounds tested for anthelminthic power, carbon tetrachloride was consistently the most efficacious against the sheep-hookworm. It was, however, found also to possess very definite toxic properties for sheep when given in doses from 0.1 c.c. per lb. to 0.2 c.c. per lb. body weight: four out of nine animals so treated died. It is highly probable that all these deaths should be attributed to carbon tetrachloride poisoning. Hookworms removed from these animals by the single treatment, varied from 97.5 per cent. to 100 per cent. of the total present. When given simultaneously with fairly large doses of Epsom salts, carbon tetrachloride does not appear to be nearly so toxic; in similar doses—that is from 0.1 c.c. to 0.2 c.c. per lb. body weight and in combination with a dose of two or three ounces of Epsom salts, this drug was successful in removing 100 per cent. of the hookworms present from four animals, and 98.2 per cent. from the fifth animal. No symptoms suggesting intoxication were observed, and there were no fatalities as a result of this treatment.

Tetrachlorethylene combined with Epsom salts has also been recommended as an anthelminthic against hookworms, as a result of experiments carried out chiefly on dogs, but the observations carried out here suggest that it does not possess the efficacy of carbon tetrachloride when given to sheep.

A disadvantage attached to the administration of carbon tetrachloride is that it is highly toxic if inhaled. It is therefore necessary to make use either of soft gelatine capsules, a procedure attended by a certain amount of risk should a capsule be broken in the teeth of the sheep; or to administer it by stomach tube. The latter procedure is simple, and does not entail any expense such as that of buying capsules. 15

or 16 inches of narrow-gauge rubber tubing ($\frac{5}{8}$in.), preferably of the pressure type, is attached to a small glass funnel. The free end of the tube is first dipped in oil and then gently inserted into the mouth and passed quietly over the fauces into the œsophagus. If the head of the sheep is kept straight, and care is taken to see that the attendants do not grip the animal by the throat, the whole proceeding is quite simple, and it is impossible for any accident to happen. The sheep swallows the end of the tube when it reaches the throat, and once it has been passed a few inches down the œsophagus the measured dose of carbon tetrachloride may be poured down the funnel. A strong solution of Epsom salts containing two ounces for yearlings and three ounces for large sheep, is poured down the funnel immediately after the carbon tetrachloride, and the tube is quietly withdrawn. The operation is more conveniently carried out with the sheep in the standing position. The dose recommended, as result of experiment, is 0.1 c.c. carbon tetrachloride per pound body weight, with two or three ounces of Epsom salts as indicated. It is recommended that every individual sheep should be weighed and the dose calculated accordingly, but where this is not possible the owner should weigh a number of sheep to guide him, and estimate the weights for the rest of the flock. It is the writer's experience that mistakes will occasionally be made in the estimation of weights and an occasional fatality will result.

One other compound of carbon and chlorine has proved to have a high efficacy against hookworms. It is hoped to try this product on a more extensive scale. Hexachlorethane, the drug in question, has the advantage of extreme insolubility, and consequently of being relatively non-toxic. This drug is a very light white powder, and as the efficacious dose against the sheep-hookworm appears to be about one gramme for every 4lb. of body weight, it is somewhat bulky to administer. The dose for a sheep weighing 32lbs. (8 grammes) can be given in a hard gelatine capsule, easily swallowed by sheep of this size. In this dose hexachlorethane removed all the hookworms from one sheep and 99.6 per cent. from a second animal. If the dose is diminished the efficacy of the drug is proportionately lost.

No efficient anthelminthic has as yet been found for the treatment of infestation with small trichostrongyles. The flock owner is therefore entirely dependent upon the success of general measures to prevent heavy infestation with this species.

(3) Diseases of Swine.

(A) EAST AFRICAN SWINE-FEVER.

Attempts to obtain an attenuated virus with a view to conferring immunity against natural infection and immunising domestic pigs for anti-serum production were continued.

The most promising results were obtained with virus *ex* domestic pig No. 1125; the history of this animal is as follows, *viz.* :—

Pig No. 1125 was injected subcutaneously on 11/5/25 with 2 c.c. blood in O.C.G., equal parts, of domestic pig No. 1035.

Result.—A temperature reaction commenced on 14/5/25 which contiued until 18/5/25, maximum 104.4 Fahr., animal was visibly sick during the reaction. (Blood was collected from 1125 in equal parts of O.C.G. on 18/5/25 and since then kept stored in the ice-chest at a temperature of approximately 48° Fahr.)

Note.—Pig No. 1035 was injected on 21/2/25 with virus, collected at the time of an outbreak of the disease in the Naivasha area, and died on 28/2/25 of swine-fever.

Pig 1125 was tested on its immunity on the following dates with the following results :—

28/5/25 with 1 c.c. blood of pig 1035 (for history of virus see above).

Result.—No temperature reaction or clinical symptoms.

15/7/25 with 10 c.c. blood *ex* Pig 1091.

Result.—A temperature reaction from 17/7/25 to 24/7/25, maximum 105° Fahr., ending in recovery. *No clinical symptoms noted.*

Note.—1091 reacted to virus *ex* 1035 and died of swine-fever.

7/8/25 with 20 c.c. blood, in equal parts of citrate solution, *ex* Pig 1113.

Result.—No temperature reaction and no clinical symptoms.

Note.—Pig 1113 gave a protracted temperature reaction, *viz.* : from 5/8/25 to 20/8/25 to subcutaneous injection of 1 c.c. blood in O.C.G. solution *ex* Pig 1125 of 18/5/25 and died of swine-fever on the 20/8/25.

Note.—Blood of 1125 was collected on 17/8/25 and proved virulent.

Blood of 1125 was collected on 26/8/25 and proved non-virulent.

29/9/25, with 60 c.c. of a mixture of equal parts of blood and citrate solution, *ex* Pig 1121 of 28/9/25.

Result.—On the 19th day after inoculation, *viz.*, 18/10/25, a temperature reaction commenced to swine-fever lasting till death on 25/10/25, maximum 107.2° Fahr. 23/10/25.

Note.—Pig 1121 was inoculated on 26/8/25 with 2 c.c. fresh blood of pig 1125 and did not react but subsequently contracted swine-fever by contact from a pig reacting to the same strain of virus.

Summary.

Pig 1125 reacted and recovered to an original injection of virulent blood, and when tested on its immunity with the same virus did not react; when re-inoculated with 10 c.c. blood of the same strain of virus, after passage through a susceptible pig, it reacted and recovered. On subsequent re-inoculation with 10 c.c. blood, of the same strain of virus after passage through another susceptible pig no reaction occurred, but on re-inoculation with 30 c.c. of blood of the same strain of virus after passage through another susceptible pig, a reaction occurred, commencing on the 19th day and ending in death from swine-fever on the 26th day.

Blood of pig 1121 was collected in equal parts of O.C.G., on 18/5/25, and utilised on various dates between 18/5/25 and 22/2/26 for the inoculation of susceptible pigs destined for anti-swine-fever serum production, with the following results.

Summary of Results.

Reacted and recovered but died of other causes	2= 4.6%
Reacted and died of swine-fever	13=30.2%
Reacted and recovered but died of swine-fever when tested on their immunity	4= 9.5%
Indefinite reaction and recovered and when tested on their immunity died of swine-fever	10=23.2%
Reacted but not tested on their immunity ...	5=11.6%
No reaction, died of swine-fever when tested on their immunity	9=20.9%
Total	43

The results obtained show :—

(1) That blood collected during the reaction from a domestic pig which reacted and recovered to the injection of blood of a naturally infected pig, after passage, produces inconstant results, as regards reactions and mortality, in susceptible pigs.

(2) Pigs which reacted and recovered, when subsequently tested on their immunity with blood of another pig which reacted to the same strain of virus or which were put in contact with pigs reacting to the same strain of virus again reacted and died of swine-fever.

(3) Pigs which reacted and recovered and again reacted and recovered to re-inoculation with the same strain of virus, after passage, again reacted and died when re-inoculated with virus of the same strain or when put in contact with a pig reacting to the same strain of virus.

The value of the following method of preparing an anti-serum is now being investigated, *viz.* :—

(*a*) Inoculation of susceptible pigs with an attenuated virus, to be obtained if possible by inoculation of a naturally recovered pig with virulent blood, and collection of its blood when reacting, or by collecting blood from a susceptible pig which reacts and recovers to inoculation;

(*b*) Re-inoculating the survivors with gradual increased doses of virus;

(*c*) Collection of serum from the pigs which survive inoculation with increasing doses; and

(*d*) Simultaneous injection of the serum and the strain of virus used to produce the serum followed some days later by simultaneous injection of the serum and a more virulent virus;

(*e*) Inoculation of the survivors with increasing doses of the more virulent virus.

During the period of my leave, *viz.* : June 4th to December 16th, 1926, I had opportunities of visiting Onderstepoort Laboratory, South Africa, on many occasions, and conferring with Sir Arnold Theiler on many subjects appertaining to stock diseases, and I would like to place on record the assistance given to me by the Director of Veterinary Education and Research during this period.

I was invited by the Acting Chief Veterinary Officer, Bechuanaland, to discuss pleuro-pneumonia and the method of dealing with the disease in Kenya Colony and visited the Protectorate for the purpose, and when there took the opportunity of proceeding to Livingstone, Northern Rhodesia, to discuss veterinary matters with the Honourable the Director of Agriculture and Veterinary Services.

I have much pleasure in placing on record that the staff, both professional and lay, have carried out their duties with loyalty and devotion, and take this opportunity of expressing my highest appreciation.

J. WALKER,
Chief Veterinary Research Officer.

APPENDIX E.

Annual Report of the Agricultural Chemist.

Staff.

The staff of the division is constituted as follows :—

V. A. Beckley, M.C., M.A., A.I.C., Agricultural Chemist.

M. H. Fox, B.Sc., A.I.C., Chemical Officer.

B. A. Pickering, Laboratory Assistant and Junior Clerk.

Mr. Pickering left on home leave on 29th October, 1926.

Correspondence.

593 inward and 399 outward letters were dealt with. In addition 597 reports were issued.

Travelling.

2,760 miles of extra departmental travelling in connection with soil study and experimental work were performed.

Agricultural Shows, etc.

An exhibit was staged at the Nakuru Show. One lecture was delivered to a meeting of the Coffee Planters' Union. The Senior Staff of the Division attended the East African Agricultural Conference before which papers, on " Some Soil Problems in Kenya " and " Industrial Alcohol," were read by the Agricultural Chemist and the Chemical Officer respectively.

Work Done.

SAMPLES RECEIVED—932.

Sample	Outstanding at 31–12–26	Received	Examined	Refused	Outstanding at 31–12–26
Dips ..	3	598	569	29	3
Soils ..	3	28	27	4	—
Waters ..	2	3	1	4	—
Manures and Lime ..	2	19	19	—	2
Coffee ..	—	186	186	—	—
Maize ..	—	14	13	1	—
Toxicological	—	20	10	10	—
Wireworm Remedy	—	16	16	—	—
Miscellaneous	—	48	46	2	—
	10	932	887	50	5

Routine, Dips.

Quite a number of samples of dip received in the laboratory had no mark or label to show who the senders were. As no acknowledgment of receipt or report or analysis could be issued complaints of dilatoriness have been received. It is manifestly impossible, if unlabelled dip samples are sent, for the owner to be traced. A very large number of dip samples have also been improperly addressed, a factor also delaying analysis.

Several of the samples received have been improperly taken. One sample was taken in a bottle that had been used for measuring the concentrate and was thus several times the correct strength. Surely when the value of a dip analysis is considered, proper sampling could be made personally by the owner of the dip instead, as must often be the case, of being left to a native.

RESULT OF ANALYSIS OF DIP SAMPLES.

Extent of Error	1924		1925		1926	
	No.	%	No.	%	No.	%
Within 1%	15	3.4	27	5.8	36	6.6
Between 1 and 5%	77	17.4	80	17.1	89	16.3
Between 5 and 10%	78	17.6	73	15.6	94	17.2
Between 10 and 20%	109	24.6	112	24.0	134	24.5
Over 20%	164	37.0	175	37.5	191	34.9
Too dirty to analyse	—	..	—	..	3	0.5
Totals ..	443	..	467	..	547	..

While the proportion of samples of dip wash which are dangerously incorrect has decreased during the year under review, the situation is nevertheless very far from satisfactory. With the facilities for dip testing available there is no excuse for the large number of dips dangerously incorrect. Many of these dips are as much as 90% incorrect, which fact may account for the number of dipping mishaps.

Some of the dips in areas where East Coast Fever has broken out and where three-day dipping has been instituted are under strength, in one case as much as 25%. There can be little doubt but that in cases such as this dipping must be comparatively ineffective.

Another point that is most striking is the great variation in strength between successive samples.

The following group of figures will illustrate this;—

January—33% over;
February—92% over;
March—60% over;
April—28% over;
July—7% over;
September—50% over;
October—10% over;
November—Correct;
December—25% over.

These extraordinary variations in strength make one wonder if the addition of water or of the concentrate are not made by guess-work and if the dipping tanks are provided with any means of measuring the volume of the contents.

Many of the samples of dip received have been very dirty, the amount of insoluble material in many of them being so great that the dipping fluid must be a thin mud. Under such conditions it is highly probable that there is a loss of efficiency in the fluid. Three samples have been so dirty that it has been impossible to analyse them.

Soils.

There is a widely held belief that a soil analysis will tell one everything about the soil; its manurial requirements, its behaviour under cultivation and its suitability for various crops. A chemical soil analysis is a most empirical procedure. All it tells is the amount of the various constituents that are extracted under certain standard conditions. The interpretation of the results of the analysis which is the reason for the analysis can only be made on comparison with the results of analyses made on samples of typical soils. Very often advice upon manurial treatment can be given from experience of the soil type in question, and if a sample be submitted, an examination of the soil for structure, nature and acidity will be of as much value as a full analysis. Such has been the examination accorded the soil samples received during the year.

Sometimes a soil condition may call for analysis but generally these cases involve special sampling, the method to be employed depending upon the features of the case. In these cases the information obtained from the analysis is worth the charge made.

Manures and Lime.—Many of these analyses have been of the manures used in the manurial experiments being conducted and of the experimental green manures. Beyond lime there is little call for routine analyses in Kenya.

Coffee and Maize.—Practically all these samples have been taken in the course of experimental work. The few samples of maize that have been sent for moisture determinations have been sent improperly packed. It is essential that such samples be sent in an air-tight container as there is otherwise an exchange of moisture between the samples and the air.

Toxicological.—The majority of the samples submitted were of suspected arsenical poisoning.

Miscellaneous.—This category contains such materials as oil seeds, tan barks, rocks, etc. A group of Wakamba-grown castor oil seeds taken at the Machakos Show had high oil contents. The highest was just under 53%, an extremely good figure. Most of the samples ran over 50%. The appearance of the seeds was also most pleasing.

Sampling.—The laxity in sampling dip washes has already been commented upon. There is also a carelessness in sampling other materials. In most agricultural chemical analyses very small amounts are being estimated, the effect of any foreign material is sufficient completely to alter the results of an analysis. For example if a sample of water be taken in a whiskey bottle, it is essential that the bottle be well rinsed with the water being sampled. The few drops of whiskey left in the bottle can, after acetic fermentation has taken place, alter the reaction of the water from alkaline to acid and thus the nature of the water. This will serve to show how important it is to take samples with the greatest care.

Coffee Fermentation.

It has long been accepted that the fermentation of coffee is caused by the combined action of a type of yeast and a variety of lactic acid bacteria. The study of the process of coffee fermentation was commenced with a view to ascertain if the end point of fermentation could not be determined by means of a simple test.

The first experimental fermentations indicated that there was a possibility of this being done. On carrying the investigation closer and conducting the fermentations at a definite fixed temperature, it was found that the rate of acid production was most variable. If acid producing bacteria were always present in fermenting coffee it is to be expected that, in one pulping at least, there would be an even production of acid. A microscopical examination of fermenting coffee failed to reveal the presence of yeast which, if it were an agent in fermentation could be expected to be present in great quantity. Fermentation of coffee, *i.e.*, the liberation of the " saccharine matter " from the parchment must be due to some other cause.

A sample of freshly pulped coffee was placed in a flask with a suitable antiseptic. This antiseptic completely prevented the growth of any yeasts or bacteria. Nevertheless after the lapse of a period the " saccharine matter " came away freely from the parchment, in other words the coffee was fully fermented. This observation has been substantiated

many times. Further experiments have confirmed the hypothesis that the fermentation of coffee is caused by a ferment or enzyme in the " saccharine matter " itself. A study of the changes shows that the process consists in the breaking down of the sticky " saccharine matter " to sugars and the slimy solid material.

The action of ferments is slowed down as the reaction proceeds by the products of the reaction. If it be possible to remove the products of the reaction or one of them at least, the speed of the reaction will remain high. It was found that the sugars produced are fermentable. It should thus be possible by the aid of yeasts to remove the sugars as they are produced, and so speed up the fermentation. This supposition has been tested in the Laboratory. A single pulping of coffee was divided into four lots. One lot was left undisturbed to undergo normal fermentation. One lot was inoculated with yeast obtained from the Kenya Brewery. Two lots were inoculated with strains of yeast developed from the brewery yeast. These four lots were placed in an insulated chamber in which there was very little temperature variation. After eighteen hours the two lots that had been inoculated with the special yeast were fully fermented and washed very readily. In twenty hours the lot inoculated with brewery yeast was fully fermented and washed easily. At twenty-four hours the lot undergoing normal fermentation was washed. It was not yet fully fermented and it required a lot of washing to clean it. Probably another two hours would have completed the fermentation. The first three lots had a very pleasant faintly acid smell. The level of acidity had increased very little beyond that of freshly pulped coffee. The one undergoing normal fermentation had a clean, pleasant smell but the level of acidity was appreciably higher than that of the first three samples. At the time of writing it has not been possible to try this inoculation method of fermentation on the factory scale, but it is hoped to conduct a fermentation at an early date.

The saving in time is not the only advantage of this method of fermentation. In the normal method of fermentation the organisms present are chance organisms. The products of fermentation may be deleterious to the coffee. In the inoculation, organisms whose nature is known are used, the product will be of a definite quality and, owing to the large number of organisms present, the effect of chance organisms will be minimised.

The observations made during this investigation will be embodied in a scientific paper to be published elsewhere.

TABLE I—GREEN MANURES.

SHORT RAIN SEASON 1925—1926.

Plot No.	Crop	Date of Planting	Date when ready to turn in.	Dry Matter per acre lbs.	Nitrogen per acre lbs.	Remarks.
1	Hubam Clover: Melilotus alba	11–11–25	—	—	—	Unsuitable. Poor germination and growth.
2	Alsike Clover: Trifolium hybridum	11–11–25	—	—	—	Unsuitable. Drought stricken.
3	White Clover: T. repens	11–11–25	—	—	—	do. do.
4	Native White Clover: johnstonii	11–11–25	—	—	—	Produced a wonderful mat of growth. Would stop wash very well on slopes.
5	White Lupins. L. poly phyllus	11–11–25	—	—	—	Destroyed by army worm, suitable
6	Crotalaria incana	11–11–25	—	—	—	Growth delayed by drought. Plot continued to next season.
7	C. juncea (Sunnhemp) ..	11–11–25	—	—	—	Disappointing.
8	C. intermedia	11–11–25	—	—	—	Very promising.
9	Cowpeas Dun	11–11-25	—	—	—	Left for seed. Unsuitable.
10	,, Gray	11–11–25	—	—	—	do. do.
11	,, Kavirondo ..	11–11–25	9–2–26	3,900	107	do.
12	,, Embu	11–11–25	9–2–26	3,300	92	Erect growth promising for coffee.
13	,, Bura	11–11–25	14–1–26	2,050	62	Not as good as the Embu cowpea.
14	Canadian Wonder Bean	11–11–25	14–1–26	2,300	60	Quick growth suitable as a short season crop.
15	Haricot Bean					Quick growth but is excelled by other crops. Creeper.

GREEN MANURES.—*Contd.*

SHORT RAIN SEASON 1925—1926.—*Contd.*

Plot No.	Crop.	Date of Planting.	Date when ready to turn in.	Dry Matter per acre lbs.	Nitrogen per acre lbs.	Remarks.
16	Madagascar Bean ..	11–11–25	20–1–26	1,800	59	In spite of the low weight this crop is more promising than the previous.
17	Njahi, Dolichos lablab ..	11–11–25	20–2–26	6,150	134	Most promising for green manuring maize.
18	Field Peas	11–11–25	20–1–26	2,300	59	Promising crop for higher altitudes.
19	Soy bean gold. Glyeine hispida	11–11–25	—	—	—	Failure.
20	Soy bean yellow. Glyeine hispida	11–11–25	—	—	—	do.
21	Soy bean small yellow. Glyeine hispida ..	11–11–25	—	—	—	do.
22	Soy bean early Korean. Glyeine hispida ..	11–11–25	—	—	—	do.
23	Phaseolus vulgaris Chinese	11–11–25	14–1–26	1,600	48	Not promising.
24	Phaseolus angularis ..	11–11–25	—	—	—	Unsuitable.
25	do.	11–11–25	—	—	—	do.
26	Phaseolus aureus	11–11–25	—	—	—	Erect variety. Poor growth.
27	do. Chiroko	11–11–25	16–2–26	3,200	84	Not promising.
28	Indigofera sp. creeping ..	11–11–25	—	—	—	Complete failure.
29	Sweet Clover. Melilotus officinalis	11–11–25	—	—	—	Very poor growth no nodules.
30	Vetch	11–11–25	—	—	—	Failure.

TABLE II—GREEN MANURES

LONG RAINS 1926.

Plot No.	Crop	Date of Planting	Date when ready to turn in.	Dry Matter per acre lbs.	Nitrogen per acre lbs.	Remarks.
1	Hubam Clover: Melilotus alba	self seeded	—	—	—	Unsuitable.
2	Alsike Clover: Trifolium hybridum	29–3–26	—	—	—	Poor growth.
		29–3–26	—	—	—	do.
3	White Clover: T. repens..	11–11–25	7–6–26	8.750	218	Droughted plot. Most promising for coffee.
4	Crotolaria incana	11–11–25	—	—	—	Seed Crop. Very promising.
5	Crotolaria intermedia ..	29–3–26	—	—	—	Most disappointing.
6	Crotolaria juncea	29–3–26	—	—	—	Attacked by flea beetle. None promising.
7–16	Crotolaria spp.	29–3–26	—	—	—	Most promising; seed crop.
17	Astragalus venosus ..	29–3–26	—	—	—	Destroyed by flea beetle.
18	Cassia sp.	29–3–26	—	—	—	Failed.
19	Indigofera sp. Erect ..	—	—	—	—	Very fine mat.
20	Native White Clover ..	29–3–26	15–6–26	—	—	Not suited for green manures. Growth rather poor but these varieties are heavy croppers.
21	Cowpea. Dun	29–3–26	15–6–26	—	—	Susceptible to disease.
22	,, Gray	29–3–26	15–6–26	—	—	Promising for coffee but is excelled. Weedy.
23	,, Kavirondo ..	29–3–26	15–6–26	—	—	Chlorotic and weedy.
24	,, Embu	29–3–26	—	—	—	
25	,, Bura					
26	Pois du Cap. Phaseolus inamoenus	29–3–26	1–7–26	n.d.	n.d.	Very fine growth No weeds in plot. Very promising green manure.
27	Velvet bean	29–3–26	—	—	—	Poor gowth Very diseased and attacked by root-parasites.

GREEN MANURES—*Contd.*

LONG RAINS 1926.—*Contd.*

Plot No.	Crop	Date of Planting	Date when ready to turn in.	Dry Matter per acre lbs.	Nitrogen per acre lbs.	Remarks.
28	Njahi. Dolichos lablab ..	29–3–26	1–7–26	n.d.	n.d.	Very fine growth. Only one weed, a sodom apple penetrated the growth.
29	Dolichos lablab. White ..	29–3–26	7–26	—	—	New variety grown for seed.
30 31	Beans. 2 varieties ..	29–3–26	1–6–26	—	—	New variety grown for seed.
32	Phaseolus angularis ..	29–3–26	—	—	—	Unsuitable.
33	P. aureus	29–3–26	—	—	—	Unsuitable.
33A	New Zealand Grass Pea	29–3–26	1–7–26	3,650	131	Very fine growth. Possibly suitable for high altitudes.
34 37	Soy beans	29–3–26	—	—	—	Failed.
38	Madagascar bean ..	29–3–26	7–6–26	3,800	132	Good growth and very rapid.
39	Field Peas	29–3–26	20–6–26	4,100	182	Good growth suited to higher altitudes.
40	White Lupin. L. polyphyllus	29–3–26	2–7–26	3,705	120	Good growth suitable for coffee, seed germinates well.
41	Blue Lupin (large leaved)	29–3–26	2–7–26	—	—	Good growth rather slower than the former.
42	Blue Lupin (fine leaf) ..	29–3–26	—	—	—	New variety for seed.
43	Yellow Trefoil	29–3–26	—	—	—	Slow. New variety for seed.
44	Sweet Clover. Melilotus officinalis	29–3–26	—	—	—	Did badly.
45	M officinalis	29–3–26	—	—	—	S. A. seed better growth than previous season but not good.
46	M. officinalis alba ..	29–3–26	—	—	—	Did worse than No. 44. New Zealand Seed.

47	Subterranean clover ..	29-3-26	—	—	—	New Zealand Seed. Poor.
48	Crimson clover	29-3-26	—	—	—	Grew well but felt drought. At later stage became diseased.
49	Lotus major	29-3-26	—	—	—	Grew well but felt drought.
50	Lotus augustissimus ..	29-3-26	—	—	—	Not promising.
51	} Cowpeas. Embu varieties	29-3-26	—	—	—	Very promising as carpet growth. Stands drought.
52	}					
53	Beans white native (Cow-beans)	29-3-26	17-5-26	—	—	Selected from seed of previous season one was an erect variety—see No. 24.
54	Bean bright red	29-3-26	17-5-26	—	—	Better growth than Canadian Wonder, possible short season crop.
55	Bean dull red	29-3-26	17-5-26	—	—	Not so good as Canadian Wonder.
56	Peanut Virginia Bunch ..	26-11-25	—	—	—	Very promising but attacked by disease.
57	Cowpea: monetia.. ..	26-11-25	—	—	—	Destroyed by rust when rains came.
58	Cowpea: wonderful ..	26-11-25	—	—	—	Resistant to disease. Very promising.
59	Cowpea: iron	26-11-25	—	—	—	Destroyed by rust.
60	White velvet bean ..	26-11-25	—	—	—	Diseased.
61	Velvet bean. Common Florida	26-11-25	—	—	—	Diseased.

Nos. 56–61 although planted in November, 1925 are considered in this group as all growth was made during the long rains of 1926.

Green Manures.

In the last annual report of this division the need for green manuring in Kenya was discussed. During the year the practice of green manuring has been widely advocated. It is gratifying to be able to report that many planters and farmers are taking up the practice. On the whole it may be said that the coffee planters have seen the advantage of green manuring and are widely beginning to follow the system of cover cropping advocated. The maize farmers are slower in following the practice but several have expressed their intention of green manuring a portion of their fields. It is hoped that when results obtained by these pioneers become known, more and more farmers will become converted.

The results of two seasons' experiments at the Scott Laboratories conducted in conjnuction with the Agricultural Supervisor on varieties of legumes thought to be possible green manures are now available. These are given in Tables I and II. Many of the crops tested are crops that are used elsewhere, some are local varieties while others are indigenous. It has been observed that some of the varieties used in other parts of the world fail miserably when tried here. In some cases, notably sweet clover and vetch, it has been found that very much better results are obtained from locally produced seed. In the case of the former, the plant seeded when about four inches high, chance distributed seed from these plants germinated in plots sown with imported seed, these second generation plants grow faster and taller than the first generation plants. In the case of vetch a group of third generation plant is now growing, these notwithstanding drought are much larger than the first generation plants grown from imported seed. The value of acclimatised seed is evident.

Many planters in Kenya are familiar with conditions obtaining in other tropical countries or refer to text books based upon observations made under those conditions and wish to apply the system followed to Kenya. Green manuring with certain plants is one of the items in these systems. They desire to use these advocated plants. In many cases they are doomed to disappointment, as has been learned during the course of these experiments. Sunn hemp, *Crotolaria juncea*, and velvet beans are two very widely used green manure crops. Under conditions obtaining through the Kenya highlands both of these crops do badly and are far surpassed as cover crops by local varieties. Planters and others interested in green manuring would be well advised to use the varieties found suitable after experiment by officers of the Department, rather than use untried varieties and, probably having been disappointed, become opposed to green manuring.

Besides the main trial plot at the Scott Laboratories, a few small observation plots have been placed in different parts. Upon the results obtained to date and upon observations made, the following recommendations are advanced :—

PLATE 3.

Dutch Runner Bean for green manuring at Scott Agricultural Laboratories.

1. For cereals up to 6,500 or perhaps up to 7,000 feet the following are suitable for green manuring, in order of merit :—*Dolichos lablab ; Phaseolus inamoenus, Pois du Cap ;* Wonderful Cowpea ; White or large leaved blue lupin ; Madagascar bean ; Field peas ; Embu Cowpea ; Cow bean and Canadian Wonder bean.

2. For coffee the green manures, in order of merit, advocated are :—*Crotolaria incaua ; Crotolaria intermedia ;* Lupins as above ; Embu Cowpea ; Cow bean and Canadian Wonder bean.

3. Above 7,000 feet up to 8,000 feet *Crotolaria incana* and *intermedia* both do well. Field peas have been seen growing strongly over 9,000 feet but sufficient data have not yet been obtained to make any recommendations for these higher altitudes. A group of trial plots has been arranged.

One of the greatest difficulties in connection with green manuring will be the seed supply. Njahi or *Dolichos lablab*, field peas and the Embu cowpea are native grown crops, and can be obtained, though sometimes with difficulty. The *Paseolus inamoenus* was obtained in a native shamba but none has been seen on the market. A small supply of lupins is available but not sufficient to meet the demand. A small amount, about 30 lbs., of *Crotolaria incana* seed has been issued for multiplication purposes while next season the supply of *Crotolaria intermedia* seed available at the Scott Laboratories will allow of a similar issue being made. These small issues will permit of the recipients growing sufficient seed to green manure a small area only. At the present stage of the demands for green manure seeds it would not be a safe procedure for a farmer to undertake the production of seed. Within a few years it is believed that the demands will be such that it will be a paying proposition for certain farmers to undertake the supply. Meanwhile unless a farmer anticipates and devotes a small area to seed production he will probably be disappointed when he tries to purchase seed to green manure a large area.

Manurial Experiments.

During the past year the farming community as a whole has evinced an interest in manuring. There have been many queries received regarding manuring and it is evident that there has been a great increase in the sale of fertilisers.

A note of warning must be sounded. Theoretically good farming practice involves maintaining the level of soil fertility at a high level by returning to the soil as much available plant

food as has been removed by the crop. Economically, good farming is paying farming. Manuring should only be practised when it pays. A farmer should not enter blindly into an extensive scheme of manuring but should determine by means of a small experiment if his projected scheme of manuring will pay.

In connection with the maintenance of soil fertility it must be remembered that it is cheaper and simpler to maintain a high level of fertility than to attempt to restore such a high level to a depleted soil. Even if a soil be producing very fine crops and it be found that an expenditure of a small sum per acre on manure gives a profitable return, it will be cheaper to maintain that high level of fertility, at perhaps a lower initial rate of return on outlay, than to work the soil unmanured until the rate of production falls to a point where manuring gives an outstanding result, the decreasing returns before manuring in the latter will more than balance the lower rate of return in the former system.

Of the manurial experiments in progress those in co-operation with farmers on maize are being conducted on the economical basis. The Scott Laboratory experiments and the coffee manurial experiments are being conducted to determine the effect of manures on the plant.

Scott Laboratory Experiments.

The crop grown on the Scott Laboratory plots was Kenya Governor wheat. The plots were sown on 23rd and 24th March and were harvested at the end of July. The rainfall totalled 20.97 inches and was distributed as follows :—

March	...	4.43 inches
April	...	9.11 inches
May	...	5.43 inches
June	...	1.37 inches
July	...	0.63 inches

This plentiful supply of rain enabled the crop to make the greatest use of the nutrients in the soil. The effect of the manures was generally not visible and in the final results not marked.

As a result of the plentiful rain the straw growth was heavy and in May the crop began to lodge. Before the laid straw had a chance to recover fresh showers increased the lodging, so that by the time the crop ripened practically the whole of the field was lodged. This made harvesting very

difficult and wasteful. The error per plot in harvesting is computed to be of the order of 5 per cent. The average yield of grain per acre was 12.2 bags of 200 lbs., which means that the harvesting error was roughly 0.5 bags per acre; the average straw yield was 5,350 lbs. per acre giving an error of some 250 lbs. per acre. As the maximum increase in grain per acre is of the order of 0.5 bag per acre the results for the past season can only be taken as qualitative.

The results of the analysis of the yields per plot are given in Table III.

TABLE III.

MANURIAL EXPERIMENTS—SCOTT LABORATORIES, 1926.

Manure	Application of active constituent per acre.	Increase in grain per acre. Bags	Increase in straw per acre lbs.
Seychelles guano ..	40 lbs. total P_2O_5	0.55	850
Bone meal	do.	0.05	650
Basic slag	40 lbs. citrie soluble P_2O_5	0.25	1000
Super phosphate ..	do.	0.15	900
Lime	1000 lbs.	0.25	100
Sulphate of Potash ..	20 lbs. K_2O.	—0.15	—100
Sulphate of Ammonia	20 lbs. N.	—0.25	—300
Nitrate of Soda ..	do.	—0.90	—100
Green Manure ..	Field Peas	—0.35	—200

Coffee Manurial Experiments, Kassarini.

These experiments have given their first crop since manuring. The season has been so late that at the time of writing the plots have not yet been stripped. The record of the crop harvested is thus not available for this report.

The crop this year has been very free from "lights," the percentage present being in the region of only about 2 per cent., last year the percentage was very high, numerically it must have been well over 50 per cent. On the whole the crop is very bold, there is also a great deal of peaberry and a fair amount of "Elephant" beans.

This season the effect of the manuring on the general vigour of the trees is visible. The trees in the control plots are on the whole in very poor leaf and are rather yellow. It also appears that the flowering this season will be rather small. The conditions on the manured plots are very satisfying. The trees have a good and healthy leaf covering and promise to give a good flowering. The limed plots are very good. The

difference between a control plot and the corresponding limed plot is most marked, the limed plot being well leaved and the trees looking healthy.

Both manuring and liming have had a good effect upon the vigour of the trees and it is certain that they will be in a better position to stand the strain of a heavy crop than the unmanured. It is believed that next season the effect of the manuring will be reflected in both the quantity and the quality of the crop. Very probably it will be possible after the next crop to make tentative suggestions for a system of manuring coffee.

Experiments on Maize.

In the Nakuru area where these plots are situated the weather conditions have been most conducive to the production of heavy crops. Here too, as at the Scott Laboratories, the supply of water in the soil has enabled the plants to make the best use of the nutrients in the soil. The effect of the manures applied has not been as striking as it may have been during a drier year. Nevertheless the results do show that crops benefit by being treated with phosphates.

The season in the Nakuru area has been very late, harvesting not commencing until the beginning of December, and in the case of two of the three groups of experimental plots, harvesting of the plots could not be performed during the period under consideration. The results of these plots are therefore not available for insertion in this report. The results of the experiment conducted in conjunction with Mr. J. Mackay, Rongai, were however obtained. In these experiments the maize was rather wet so moisture determinations have been made on samples taken from the crop from each plot and the results calculated to a basis of 12.5 per cent. moisture.

Twelve plots were placed here. These in the coming season will be divided into halves, one of which will be green manured while the other will be planted to maize. The results of the experiment are given in Table IV, the assumption being made that the soil varies evenly between control plots. The variation between the control values is unsatisfactory. The soil may be extremely variable or some untoward occurrence has affected the yields. Mr. Mackay observed heavy wash diagonally across the plots shortly after planting and suggests that part of the manure was washed from the manured to the unmanured plots. However, no account has been taken of this possibility.

TABLE IV. YIELDS, MANURIAL EXPERIMENT ON MAIZE—J. MACKAY Esq., RONGAI.

Plot No.	Treatment quantities per acre.	Yield in lbs.	Moisture %	Yield at 12.5% moisture lbs.	Control Value bags per acre.	Yield bags per acre.	Increase bags per acre.
1	Control. ..	658	15	644	17.2	17.2	—
2	100 lbs. Seychelles guano ..	692	15.2	675	16.7	18.0	1.3
3	200 lbs. Seychelles guano ..	649	14.8	636	16.2	17.0	0.8
4	Control ..	600	14.9	588	15.7	15.7	—
5	100 lbs. Seychelles guano and 50 lbs. Sulphate of Potash ..	562	14.1	544	14.8	14.8	Nil.
6	200 lbs. Seychelles guano and 50 lbs. Sulphate of Potash ..	593	14.5	583	13.9	15.5	1.6
7	Control ..	496	14.4	488	13.1	13.1	—
8	100 lbs. Seychelles guano ..	587	14.4	578	14.3	15.6	1.3
9	100 lbs. Seychelles guano and 50 lbs. Sulphate of Potash ..	663	14.0	654	15.6	17.4	1.8
10	Control ..	652	14.9	633	16.9	16.9	—
11	200 lbs. Seychelles guano ..	678	13.9	670	15.8	17.9	2.1
12	Control ..	559	14.2	551	14.7	14.7	—

The average yield over the whole area is 16.1 bags while that of the unmanured plots is 15.5 bags. Under such conditions it can hardly be expected that the effect of the manures will be marked. Nevertheless the application of 100lbs. of Seychelles Guano has given an increase of 1.3 bags per acre, or on the basis of the figures supplied by Mr. Mackay for farm values of manure and maize a net profit of at least Sh. 4 per acre. The increase from the application of 200lbs. of Seychelles Guano per acre on Plot 2 is strangely low, that on Plot 11 seems to be more probable. However the average increase is 1.5 bags per acre, which would result in a net profit of about 50 cents. per acre. The yields from the plots receiving Sychelles Guano and sulphate of potash indicate that the sulphate of potash has affected the yield somewhat. The nett result however of its use is a monetary loss.

General.

During the year a Mansfield gas plant was erected to supply the Scott Laboratories with gas. This has completely replaced the inefficient heating system of primus stoves and spirit lamps, and greatly facilitated work.

The area lying between Menengai, Njoro, Rongai and Lower Molo has been closely studied during the year. A preliminary soil map has been drawn and a number of soil samples taken. As chance permits the map will be corrected and the soil mapping extended.

The vegetational distribution on the various soil types has also been noted but at the present stage in the Colony's development lack of staff prevents as close a study as necessary being made. There is no doubt in the writer's opinion that the natural vegetation provides a very good indication of the possibilities of the soil, but until data have been accumulated the interpretation of the vegetational variations cannot properly be made. The observations made so far form a beginning of the accumulation of data.

The thanks of the department are due to Messrs. H. Douglas, of Kassarini, J. Mackay, of Rongai, G. Sutton and H. P. Moller, of Nakuru, for the land and assistance given in connection with manurial experiments.

V. A. BECKLEY,
Agricultural Chemist.

APPENDIX F.

Annual Report of the Entomologist.

Staff.—No changes.

Travelling.—6,252 miles were travelled by car on Government service :—

T. W. Kirkpatrick ...	3,195 miles
T. J. Anderson ...	3,057 miles

The number of nights spent away from the Laboratory during visits to plantations and research work in the field were :—

T. W. Kirkpatrick	27
T. J. Anderson	69

Correspondence.—1,167 letters were dealt with; the subjects are summarised as follows :—

Bees and wax	9
Blood-sucking flies and ecto-parasites	59
Citrus	10
Coffee	244
Cotton	9
Cutworms	27
Flowers	11
Fruit and fruit trees	13
General	137
Identification of insects ...	27
Importation of plants	258
Locusts	11
Maize	64
Sericulture	37
Staff	103
Tea	7
Termites	3
Tobacco	2
Upkeep of Laboratory ...	117
Vegetables	13
Wheat	8
	1,167

Publications.

"The Coffee Mealybug, Recommendations for Control Measures," T. W. Kirkpatrick, Local Press, March 6th.

"Insect Pests of the Maize Crop," T. J. Anderson, Bulletin 5, Department of Agriculture.

Papers were read at the Agricultural Conference held in Nairobi in August. These will be published in the report of the Conference.

Routine.

Some 250 specimens of insects, damaged plants, seeds, etc., have been examined and reported on.

235 applications for permits to import plants and/or seeds have been examined, passed or amended.

Consignments of plants, parcels or packages, have been examined at the General Post Office.

Certificates of cleanliness have been given for the export of plants and coffee to neighbouring Territories.

Exhibits were prepared and staged for the Agricultural Shows at Nakuru.

The collections have been added to considerably.

Insects of Economic Importance during the Year.

The more important pests are here recorded under the crops which they attack.

COFFEE.

(*a*) *Mealybugs.*—During the year Mr. Kirkpatrick has given his undivided attention to the study of the mealybugs affecting the coffee plant. He reports as follows :—

The following species of mealybugs are known to occur on coffee in Kenya Colony. I am indebted to Messrs. E. E. Green and F. Laing for the identifications.

1. *Ferrisia virgatus*, Ckll.
2. *Pseudococcus perniciosus*, Newst. & Will.
3. *Pseudococcus*? *comstocki*, Kuw. Green; ? n.sp. Laing.
4. *Pseudococcus citri*, Risso.
5. *Pseudococcus lilacinus*, Ckll.
6. Another mealybug, probably *Pseudococcus longispinus*, Targ., occurs in the Turbo Valley district. It has, however, not been possible to do any work on this species.

Ferrisia virgatus, Ckll.

This is a large mealybug which can readily be recognised as follows : abdomen terminating in a pair of long, rather stout, waxy " tails," the rest of the body with numerous very delicate long wax filaments, having the appearance of very fine spicules of glass. In the full-grown insect there are a number of pairs of dark spots on the dorsum, where the body

colour is seen through the waxy secretion. This species occurs chiefly in the Kakusi and Donyo Sabuk districts. It is generally only found on one or two trees and only one case has been reported where it appeared to be assuming serious proportions. In this case however, it seems to have been successfully controlled by natural enemies.

Pseudococcus perniciosus, Newst & Will.

This is a rather large, more or less globular species of a purplish colour when squashed, covered with a thick layer of yellowish white wax, but having no distinct waxy filaments. It is not uncommonly found affecting isolated trees, but no case has been reported of its becoming epidemic.

Pseudococcus comstocki, Kuw.

In general appearance this mealybug is very similar to *P. lilacinus*, Ckll. In microscopic preparations it can readily be distinguished from that species by its having only 34 cerarii instead of 36. So far it has only been found on a single tree at the Scott Agricultural Laboratories, and on a few trees on one plantation near Thika.

Pseudococcus citri, Risso.

All the mealybugs so far found affecting the roots of coffee plants in the Colony have been now identified as this species. It has occurred on young plants in a nursery at Kyambu and on a few older plants on one plantation near Thika. Strict measures were taken with regard to both these outbreaks and it is hoped that this species has been exterminated. No case has yet been notified of this species living above ground on coffee in this country. In the first case (at Kyambu) it was attended by the ant *Paratrechina jægerskjœdi*, Mayr., and in the second by *Acantholepis capensis*, Mayr.

Pseudococcus lilacinus, Ckll.

This mealybug (formerly known in this country as *P.citri*, Risso.), is the one which during the past few years has assumed epidemic form, especially in the districts of Thika, Ruiru, and parts of Kyambu. In contradistinction to the previous species, it has so far never been found on coffee below the soil level. In most cases, and so far as is known, in every instance where it has become a serious menace, it is attended by the ant *Pheidole punctulata*, Mayr. Other ants that have been found attending *P. lilacinus* in certain districts are *Technomyrmex albipes*, Sm., at Kyambu; and *Pheidole speculifera*, Em., at Kabete. However neither of these species appears to exert the same influence on the mealybug, and no instance is known of the mealybug obtaining a firm footing in a coffee plantation if only attended by either of these two ants.

Work has therefore, in the main, been confined to the *lilacinus* mealybug, and principally to those areas where it is attended by the ant *P. punctulata*.

The statement made in the Report for 1925, that if this ant were denied access to a mealybug infected tree, the mealybug would be cleaned up by its natural enemies, has in almost every instance been justified in practice. Some plantations, however, become reasonably clean much quicker than others, within three or four weeks in exceptional cases, whereas on a few the results are distinctly disappointing. As, however, it is impracticable to make sufficiently frequent visits to many plantations, it is possible that on those where the results are poor, the ants have not been efficiently prevented from obtaining access to the infected trees.

The following is a summary of the present recommendations for the control of the *lilacinus* mealybug in the presence of the ant *Pheidole punctulata*.

The " Cresoto " method of tree-banding, as first described in an article published in the *East African Standard* of March 6th, 1926, in spite of its many disadvantages, is still the best that can be recommended. Cotton wool or some similar packing should always be used under the grease-proof paper and americani band. The cheapest grade of ginned cotton obtainable from Uganda (at about 60 cents. per pound, f.o.r. Nairobi) is probably the best material for this purpose. In view of its low price, a considerable amount can be used, and it serves the double purpose of protecting the tree and affording a place in which certain species of lady-birds will be found to pupate. It also attracts the immature male mealybugs, which are there devoured by lady-birds. Probably the best method of fastening the bands to the tree is by means of a tin-tack pushed in with the thumb, not hammered in. A tight string round the trunk is undesirable.

On young and rapidly growing trees great care must be taken that the " Cresoto " does not soak into the bark.

Paper cones soaked in " Cresoto," as described in No. 1, Vol. 1, of the *East African Farm and Home Journal*, will be found safer for protecting young trees from ants; they are fairly efficient if a coarse absorbent unglazed paper is used. Thin glazed brown paper is useless. Newspaper, if used two or three layers thick, has been found reasonably effective.

It need scarcely be repeated that banding is useless unless constant care is taken to see that there is no other means of access from the ground to the tree, such as weeds, prunings, suckers, or overhanging shade trees.

As regards other ant-repellents that have been tried, " Wormite " or similar substances containing naphthalene are efficient only in dry weather. Paris green, for numerous reasons, is unsatisfactory and unsafe.

It is also recommended that, so far as is consistent with other requirements of the cultivation of coffee, plantations affected with mealybug should be opened up as much as possible to the wind.

It is not advisable to spray large areas of infected trees, owing to the resulting wholesale destruction of beneficial insects; there is, however, no objection to spraying isolated trees where it appears impossible to protect the trees from ants; *e.g.*, should the young shoots of a stumped tree become infected with mealybug and the stump be too short to band effectively.

The castor oil soap and solar oil spray, as described in the *East African Standard* of July 29th, 1925, is as efficient as any.

Where a fresh outbreak of mealybug occurs in a limited area, it is well worth while attempting to exterminate the ants by the use of hot water, digging up the nests and pounding them with a heavy stone, or some such method. This is best done after rain when, the soil being damp, the queen and the immature stages of the ants will be found nearer the surface than when the ground is dry. It is of course an impracticable method on a large scale.

Work is now in progress on a method of banding trees to protect them from ants, which it is hoped will prove simpler and more permanent than the present methods. It is, however, too early as yet to make any definite pronouncement as to its value.

Investigation of the natural enemies of the mealybug has been continued and there are now known some forty species of predaceous insects which destroy *Pseudococcus lilacinus*; only about twelve of these, however, are sufficiently abundant to be of much practical value.

One species of an internal hymenopterous parasite is also known, but it appears to be exceedingly rare.

Two other internal hymenopterous parasites have been discovered, one living in a mealybug growing on a species of hibiscus at Kyambu, and the other in one on an unnamed shrub at Ruiru. Both these mealybugs have been identified as *P. lilacinus*, but seeing that neither of them appeared able to live on coffee, nor could either of their parasites be induced to attack the *lilacinus* mealybug growing on coffee, it would appear that they are distinct biological species.

The breeding and distribution of the imported *cryptolæmus* lady-bird has been discontinued. It was found that when these were liberated they were all destroyed by the ants within three or four days. In one case where they were liberated on

protected trees, some could be found after a lapse of a month, by which time the food supply on these trees was becoming scarce and the *cryptolœmus* presumably wandered to adjacent unprotected trees where they fell a prey to the ants."

(*b*) *Other Scale Insects.*—Other scale insects reported during the year were :—

Asterolecanium coffeæ, Newst., Thika, Donyo Sabuk, Kyambu. Severe damage has been caused by this scale on several plantations.

Pulvinaria psidii, Maskl., Nyeri.

Ceroplastes ceriferus, And., Kitale, Sotik, Nyeri, Ngong, Makuyu, Subukia. In many instances this scale was, by planters, mistaken for mealybug.

Coccus Africanus, Newst., Green Scale, Songhor, Sotik, Ngong, Kitale. The specimens from Sotik were parasitised to over 90 per cent.

Selenaspidus articulatus, Morg., The West Indian Red Scale, Sotik.

Ischnaspis longirostris, Sign., Nanyuki.

(*c*) *Leaf-eating Caterpillars.*

1. *Parasa vivida*, Walk., the Stinging Caterpillar, has not been so much in evidence, although reports were received of damage being done in widely separated areas. The pupal stage of the moth lasts for about one month ; the caterpillar is capable of doing damage for five to six weeks.

2. *Metadrepana andersoni*, Tams. Severe outbreaks have occurred in the Fort Ternan, Songhor and Koru areas. In the laboratory the female moth laid, on an average, 64 eggs. The caterpillars vary in colour from dark green to brown ; the anal segment is prolonged into a long tail-like process which is raised in repose ; the front part of the body is humped. When full fed the larvæ, often two or three together in one curled up leaf, enter the prepupal stage, which lasts for about five days, and then turn to pupæ. From the pupæ the moths emerge in, on an average, twelve days. Two or three days afterwards the female begins to deposit her eggs and continues to do so for two to three days.

Egg stage ...	...	9 days, average
Larval stage	...	22 days, average
Prepupal stage	...	5 days, average
Pupal stage	...	12 days, average

One generation, *i.e.*, from egg to egg, is thus complete in fifty days and in the laboratory one generation followed another continuously throughout the year.

The caterpillars are exceedingly voracious and are capable of doing great damage in a very short time. In the Songhor area eighty acres were defoliated in a few days. As a rule the berries are not eaten, but when the tree is nearly defoliated the young tips are attacked and destroyed. No natural enemies have as yet been discovered.

The control method is that generally used for all leaf-eating insects, *i.e.*, spraying with arsenate of lead, 4lbs. to 100 gallons of water. As this is not always an easy matter, water and sprayers not being available, hand picking or crushing has been tried with success.

3. *Chloridea obsoleta*, F.—In the beginning of the year, during the dry weather, considerable damage was done to foliage and green berries in the Ngong district, by the caterpillars of this moth. This was evidently exceptional and the pest has not since appeared in that area; over 50 per cent. of the caterpillars were parasitised by Tachina flies.

4. *Odites artigena*, Meyr.—The first record of damage done by the caterpillars of this moth was from Kyambu in 1920, and it was not recorded again until 1926, at Kyambu.

   The young caterpillars eat the epidermis of the leaf in patches; later holes are eaten in the leaf and later still a considerable part of the leaf is eaten.

   The caterpillars live under a very delicate silk web and finally pupate under such a web. For five specimens the records were as follows :—egg, 13 days; larva, 54 days; pupa, 4 days. The average number of eggs laid by the female was 184. She began to lay one day after hatching and continued to do so for five days. I am indebted to Professor Janse, Pretoria, for the identification of the moth, which belongs to the family *Xyloryctidæ* of the *Microlepidoptera*.

(*d*) *Berry Borers.*—Two new berry borers have been reported for the first time. One, a new species, has been identified by Mr. Meyrick as *Eucosma nereidopa*, Mayr., the other, from Sotik, has not yet been identified.

(*e*) *Stem Borers.*—*Apate monacha*, F., the Black Borer, was reported from the Makuyu, Kericho, Ngong, Solai and Subukia areas.

(*f*) *Thrips;* from Koru, Ngong, Cherangani and Solai.

(*g*) *Fruit Fly.*—Coffee cherries as they ripen are favourite hosts of the fruit fly, *Ceratitis capitata*, Wied. The larvæ attack only the sweet pulp surrounding the beans. They do not damage the beans, but when the pulp has been eaten the skin of the cherry is inclined to adhere to the

beans, which makes pulping a little more difficult. "Chemical analyses of beans from infested and uninfested cherries, tasting tests of coffee made from similar roasted beans and weighings made of dried beans have failed to reveal any ill effect to the beans themselves due to fruit fly attack."—(U.S.A. Bulletin 640.)

(*h*) *Antestia.*—Several small outbreaks have been reported during the year. In most cases use of the poison spray has been found effective when properly made and applied. In one instance a planter stated that the spray proved very deadly to all insects *except Antestia*, but no further details were supplied.

COTTON.

Between the 7th and 14th of November, Mr. Kirkpatrick visited the cotton cultivation on the Coast—small areas on Mombasa Island and in the vicinty of Takaungu; Malindi and Ganda and the more extensive areas in the neighbourhood of Mambrui where the bulk of the cotton is grown. His report is as follows :—

The following were observed :—

Patyedra gossypiella.—Pink boll worm. Universally distributed—the first record for the Colony.

Dysdercus spp.—Cotton stainers. Universal, except that they were not noticed at Takaungu.

Oxycarenus hyalinipennis.—Cotton seed bug. Universal, though less abundant at Mambrui than elsewhere.

Earias insulana.—Spiny boll worm. Malindi and Mambrui—scarce.

Chloridea obsoleta.—Boll worm. Traces of damage probably caused by this species observed at Ganda—not of importance.

Nezara sp.—Green stink bug. Malindi, not common.

Pseudococcus virgatus.—Mealybug. Mombasa, scarce.

Pseudococcus sp.—Mealybug, Ganda, scarce.

Aphis sp.—Ganda, seen on one plant only.

Only the first three of these pests appear to be of any importance.

1. *The Pink Boll Worm.*

As the seed from which all the cotton on the Coast originates appears to have come from Uganda (where the pink boll worm is said not to be present) it is suggested that this pest either spread up the coast by breeding on wild malvaceous plants from Zanzibar, where it is said to occur, or was introduced in unginned cotton used perhaps for bedding or packing and brought by Arabs in a dhow. Alternatively, that it is indigenous to this part of the world, a theory that is

at variance with that of most authorities but is perhaps supported by the fact that it is parasitised much more heavily than would be likely if it had only been introduced within the past three years. In any case it is now firmly established. It is difficult to estimate the loss caused by this pest, but it was probably at least 15 per cent. of the first picking. It is not yet known whether it increases during the cotton season, or whether it is kept in check by its parasite. An examination of the seeds of sound cotton from different localities showed the following percentages attacked by pink boll worm.

Malindi—cotton on trees	13%
Mambrui—cotton on trees	13%
Mambrui—1st quality 1st picking cotton brought for sale	5%
Mambrui—last years seed used for sowing this year	20%

These figures give no indication of the total loss, as there are a large number of bolls rendered totally " unpickable."

Of 16 such " unpickable " bolls collected at Malindi, 12 contained 23 living pink boll worm larvæ, the other four bolls having been destroyed by *dysdercus*.

Of 50 green bolls collected at Ganda, 6 had traces of damage by pink boll worm.

Life History.

It is probable that the pink boll worm is able to complete an entire cycle, egg to egg, within 35 to 40 days. There is thus time for at least four generations on cotton between October and the end of February.

No trace of resting larvæ were found, nor are such likely to occur in such a climate as that of the Coast. This is of considerable importance in regard to control measures.

Alternative Food Plants.

Although the pink boll worm was not actually found breeding on any other plant except cotton, all malvaceous plants should be suspected as being possible alternative hosts. The most likely alternative food plants found on the Coast were :— *Abutilon* (?*Zanzibaricum* or near species), *Hibiscus cannabinus* and a species of *Malva*.

Control.

(*a*) *Natural.*

A braconid is exercising a very efficient control of the pink boll worm. This is larval parasite, and although it is probable that it can only attack larvæ in opened bolls, by which time the damage has been done, it must be of great benefit in reducing the numbers of future generations. A predaceous mite (?*Pediculoides* sp) was found on one larva at Malindi. This is not likely to be of much importance.

(*b*) *Artificial.*

1. *Seed Treatment.*—As the resting stage of the larva almost certainly does not occur, heat or other treatment of the seed is unnecessary. It is, however, suggested that to avoid spreading this pest it should be unlawful :—

(*a*) to export from the infected area any unginned cotton.

(*b*) to export from the infected area any cotton seed within two months of its having been picked.

2. *Close Season.*—It is absolutely essential that there should be a rigidly kept close season. It is suggested that all cotton plants should be uprooted and burned by the 21st of March ; thus giving a close season of about two months. This order should also apply to Okra (*Hibiscus esculentus*) and other cultivated malvaceæ, if any. The Kenya Cotton Ordinance, 1923, paras. 7 and 8, fully provides for a close season, and for 1926 the date was ordered to be 31st March. This order has not every where been carried out, I saw one shamba at Mambrui which had been left neglected since the previous year and was informed that there were others. Also near Mambrui there are many large perennial cotton plants, of a variety different to that cultivated, which have been standing apparently three or four years. These produce no lint whatever of any value, but are a permanent breeding place for all the important pests.

3. *Destruction of Alternative Host Plants.*—As far as possible all malvaceous plants in the vicinity of cotton shambas should be destroyed, especially during the close season. The natives could be taught to know a malvaceous plant by telling them that it is any plant on which the cotton seed bug (*oxycarenus*), which is an easily recognised insect, is found breeding.

4. *Encouragement of the Branconid Parasite.*—This could be effected by picking attached " unpickable " bolls and leaving them in the field in boxes with a gauze cover having a mesh large enough to permit the escape of the braconid and small enough to retain the adult pink boll worm moth. It is not, however, expected that the native would do this.

2. *Dysdercus* sp.

This insect is causing a considerable amount of damage, perhaps 15 per cent. of the first picking (*a*) by sucking the green bolls, causing staining of the lint and in severe cases complete destruction of the bolls, and (*b*) by feeding on the seeds in open bolls and destroying their germination.

The enforcement of the close season, especially if accompanied by destruction of adjacent malvaceous weeds, will undoubtedly reduce the numbers of this serious pest. Hand picking (shaking the insects into tins containing water with a film of paraffin on top) would also be well worth while when

PLATE 4.

the insect begins to appear on the cotton. The use of traps (of cotton seed, etc.) for *dysdercus* is not recommended as, if these are neglected, they are liable to become breeding places rather than traps.

3. *Oxycarenus* spp.

These insects do not damage the lint in any way provided that the cotton when picked is spread in the sun for two or three days. They feed on the ripe seeds and thus destroy their germination power. It is probable that in the climate of the Coast *oxycarenus* breeds throughout the year; the common *abutilon* sp., also *hibiscus* (?) *gossypinus*, being its favourite hosts other than cotton. Damage to the seed can be minimised by frequent picking of the seed cotton from which it is intended to secure the seed for the next year's sowing.

4. *Note on the non-germination of seed* in the Malindi-Mambrui districts, 1926 :—

A sample of seed, said to be from that used for sowing this year, was obtained from the Indian owning the ginnery at Malindi. An examination of this seed showed :—

	Approx.
Destroyed by boll worm	20%
Destroyed by dysdercus or oxycarenus ...	51%
Hollow	4%
Apparently sound	25%
Actual germination under optimum conditions	5%

It is therefore not to be wondered at that there was an almost complete failure of germination in the field. Although the Indian stated that this seed was from first picking, first quality cotton, this appears very doubtful.

An examination of seed of the present crop, first picking, first quality, which the Indian states that he will keep for next year's sowing, showed :—

Destroyed by boll worm	4.5%
Destroyed by Dysdercus or Oxycarenus ...	23.5%
Hollow	2 %
Apparently sound	70 %
Actual germination under optimum conditions	60 %

This seed should give, therefore, much better results next year. In other years the quality could be still further improved if the cotton were picked every few days as it ripens, instead of leaving it on the trees for perhaps a month or more, exposed to the attacks of *oxycarenus* and *dysdercus*.

5. *Non-entomological Recommendations.*

(*a*) *Spacing.*—In every shamba visited the spacing was, in my opinion, much too wide. It varied from 4ft. x 4ft. and one plant per hole (2,700 plants per acre) to 3ft. x 3ft. and two plants per hole (9,000 plants per acre).

I would suggest that the spacing should be such as to produce 25,000 to 30,000 plants per acre, and would recommend 30-36 inches between the rows and 15 inches between the holes, two plants being left in the hole.

I suggest also that the Agricultural Supervisor should carry out spacing experiments on the Government plot at Ganda, trying say 24 inches by 15 inches (35,000 plants per acre), 30 inches by 15 inches (28,000 plants per acre), 30 inches by 18 inches (23,000 plants per acre), and 36 inches by 15 inches (23,000 plants per acre), and compare the yields per plot with the yields from the present practice of say 7,000 plants per acre.

If it is objected that the land is not rich enough to carry such a large number of plants : (1) in other cotton growing countries it is the general practice to plant closer on poor land than on rich, (2) the following suggestions as to rotations should be tried.

(*b*) *Rotations.*—It appears to be the general practice to grow cotton on the same land continuously. This is obviously unsound and absolutely unnecessary. I suggest the following simple two-year rotation, which includes the more important crops grown.

1st year.—Long rains (May-June), cotton planted.

2nd year.—March 21st, cotton removed.

2nd year.—Long rains, leguminous crops.

2nd year.—Short rains, simsim.

Simsim or other crops should not be planted among cotton as is at present being done. However, if cotton is grown close spaced this will be impossible.

Summary.

The following measures are in my opinion essential if cotton is to be grown on the Coast as a paying crop at present prices :—

1. Strict enforcement of the close season.
2. Immediate destruction of all the perennial cotton plants in the vicinity of Mambrui.
3. Destruction of malvaceous weeds in the neighbourhood of cotton shambas. This can never be complete, but even a partial destruction will help.

4. Hand picking of dysdercus.

5. Frequent picking of the cotton that ripens during the first month or so, and ensuring that the seed from this cotton and this only is used for sowing the following year.

6. Much closer spacing.

7. A simple rotation to be practised and cotton not to be grown in company with other plants.

I am of the opinion that these recommendations would, if carried out, have the effect of certainly doubling and probably trebling the present yield.

MAIZE.

Stalk-borers.

The two species, *sesamia calamistis* and *busseola fusca*, would appear to be indigenous. They have a wide distribution but, until recently, have not been responsible for much loss. The first has been recorded from Nakuru, Voi and the Coast; the second from Nakuru, Njoro, Rongai, Solai, Molo, Ravine, Sabatia, Nairobi, but not further east than Nairobi.

Within recent years the acreages under maize in these districts have rapidly increased. Moreover, natives in the Reserves bordering on settled areas, and even in these settled areas, never think of destroying volunteer maize. They also, especially in the valleys, plant maize at all times of the year for sale as green fodder. Such being the case, it is possible to find live borers practically all the year round. This tends to make efficient control all the more difficult.

The life-cycle has been studied and the times of the different stages appear to agree more or less with those given for South Africa and Rhodesia.

The question of times of planting, early or late, is being carefully considered, but up to the present very little reliable data is available and much more work requires to be done.

SERICULTURE.

The Imperial Institute Silk Committee have, for some years, been keenly interested in the possibility of establishing a silk industry in this Colony.

Reports on cocoons produced here have already been published.

The following short statement by the Committee has appeared in *East Africa* and other journals :—

" Practical investigation of the possibility of establishing sericulture in Kenya may be regarded as having commenced in 1920. Together with other official delegates to the Imperial

Entomological Conference, held in London in that year, Mr. T. J. Anderson, the Government Entomologist in Kenya, attended a special meeting of the Imperial Institute Advisory Committee on Silk Production, at which the opinion was expressed that Kenya offered prospects of success in silk raising. The climate is suited to both the silkworms and the mulberry tree, and the natives are of a type likely to be interested in the work.

The Silk Committee thereupon arranged for the despatch to Kenya of a supply of French silkworm eggs for the experimental rearing of the worms. A parcel of cocoons which had been raised from the eggs by natives under the general supervision of Mr. Anderson was duly received, and the cocoons were examined at the Imperial Institute and considered by the Committee to be of sufficiently good quality to be worth reeling trials. The trials were accordingly carried out and the resulting silk was found to be of promising quality and worth about 31s. per lb. in London (March 1923).

In these circumstances the Committee consider it very desirable that the experimental rearing of the worms in Kenya should be continued. They are keeping in touch with the authorities at Nairobi, and have offered to make arrangements for further reeling trials with a larger consignment of cocoons from the Colony and for throwing and weaving experiments with the silk obtained, in order to ascertain the technical qualities of the silk.

It will be recognised that the extension of sericulture depends upon the availability of supplies of mulberry for feeding the worms. The Government Entomologist has taken measures for the propagation of selected kinds of mulberry, and recently was supplied by the Imperial Institute with seed for trial planting.

Persons in Kenya interested in sericulture should communicate with the Entomologist, Department of Agriculture, Nairobi."

25-50 lbs. weight of cocoons is required for the further trials referred to and I will endeavour to supply this during 1927. Arrangements have already been made for a supply of eggs.

AGRICULTURAL CONFERENCE.

The following is a summary of the conclusions arrived at by the entomological section of the Conference, held in Nairobi in August, 1926 :—

" That much more work should be done by entomologists in regard to the ant *pheidole*, and that the question of baits and the destructions of nests is worthy of close investigation. As this ant was of great importance in Kenya, it was recommended that a thorough investigation should be undertaken in Kenya.

That the entomologists of Kenya and Uganda should meet and discuss the question of preventing the spread of *stephanoderes hampei* into Kenya, after visiting coffee areas to the east and west of Mount Elgon.

That the conditions and problems in South Africa are so entirely different from those in the tropical East African Colonies that the problem of the control of cutworms is one for solution in the various territories concerned.

That each participating territory should arrange to prepare lists of injurious insects with their food plants and status as pests, and to interchange such lists.

That, in order that the lists may be uniform, they should be compiled in the following form :—(*a*) name, (*b*) reference to original description, (*c*) distribution, (*d*) food plants and alternative hosts, (*e*) status as a pest, (*f*) predators and parasites, (*g*) further notes.

That each Department of Agriculture of South and East African territories should undertake to notify, without delay, every other such Department of the presence of a new disease or pest considered to be of economic importance.

That a study should be made of the insecticidal properties of native plants.

That uniform legislation should apply to importation of plants and seeds in Kenya and Uganda.

That steps be taken to secure from each African territory a report upon the presence or absence of pink boll worm therein, together with a carefully prepared map showing the cotton growing districts; and, if pink boll worm is present, the areas known to be infested.

That from the information so supplied, a map of Africa be prepared for the use of African entomologists showing the distribution of cotton cultivation and of pink boll worm.

That the delegation from South Africa, as represented by the Government officials and the officials of the Empire Cotton Growing Corporation, be asked to initiate this project and secure the publication in South Africa of the desired map of distribution.

That, although a great deal of experimental and investigational work has been done on Sudan, American, and spiny boll worm, this section is not in a position to make any general recommendations. No economic means of control have yet been devised, but the section is of opinion that further investigations are desirable and necessary.

That there is danger of *apion* becoming a serious pest if uprooting and burning is not resorted to, and that in Tanganyika uprooting and burning has been found to be entirely successful.

That the status of the wild food plants of the Sudan boll worm is of great importance and calls for further thorough investigation.

That the control of *aphids* and *jassids* by fungi should be further investigated.

That a wider survey is necessary before any definite information can be supplied in regard to the natural occurrence of major pests, and their occurrence under conditions of cultivation.

That, in view of the immense importance of cotton staining and internal boll-rots to the future development of cotton growing in Africa, it is recommended :—

That thorough investigations should be undertaken into the problem, with special reference to the possible role played in transmission by *dysdercus* and other suctorial insects.

That in some one centre an adequate staff should investigate thoroughly the whole problem in all its aspects, and that the Government of South Africa should be approached, in the first instance, with a view to undertaking this work.

That the programme of the work to be adopted should be drafted by the staff of the centre chosen for the major investigations.

That this programme should be circulated to the departments of agriculture in other cotton growing areas, with a view to complementary work being undertaken by them."

TSETSE FLIES.

In several instances where no fly had ever been found and where, from the altitude, temperature, etc., it is not possible for fly to live for long, far less breed, there have from time to time been cases of trypanosomiasis amongst cattle.

Where these have been investigated and in those cases where it was possible to trace the history of the cattle which showed tryps, it was invariably found that these animals had come from or had come through a known fly area. They therefore presumably took the disease to the district in which they finally died.

Cases of trypanosomiasis have been reported on farms adjacent to known fly areas. In some instances these cases might be traced to the herds allowing the cattle to graze in or very close to the fly area. In most instances, however, the cases have occurred miles from the known fly area and where no fly had previously been found.

As no fly had been found on these farms the outbreaks were, by some, put down to *stomoxys* and this gave rise to much discussion as to the part played by blood-sucking flies, other than species of *glossina*, in the transmission of trypanosomes.

More information, however, has recently been obtained. Trained native collectors were stationed in the area for over two months and found fly in several places, widely separated, where in my opinion it could not breed or even live for any length of time.

In these cases it seems reasonable to suppose that the fly had been brought in by game, which had come through the known fly area, and had been dropped near to where the boys found them.

In one area—the Subukia Valley—it would appear that the fly has spread up the River Lugeri from the known Kamasia fly area. In 1919 by Mr. Dry and again in 1921 by Mr. Wilkinson, this area was examined carefully and no fly were found. In December, 1925, native collectors were sent to the valley and were stationed there for some time. After the first rains in April, 1926, a few specimens were found at widely separated places in the valley and on the foothills of the Northern Aberdares. These isolated cases could be put down to game. Later on, however, specimens were taken in considerable numbers all along the river for about six miles from the fly area, which seems to point to an extension of that area. Whether the flies were breeding there or not was not determined.

Several unoccupied farms, on which the fly had been found, were put up to auction at a low upset price, and were sold, with the conditions attached that the bush for 300 yards on either side of the river be cut down as soon as possible and that the whole of the bush so mentioned be stumped and dug out within three years of the date of purchase.

The species in question is *glossina pallidipes*, and further investigation is required into its bionomics.

THOS. J. ANDERSON,
Entomologist.

January, 1927.

APPENDIX G.

Annual Report of Mycologist.

Staff Changes.

Mr. J. McDonald, Mycologist, proceeded on English leave on the 22nd September, and I took over the duties of Acting Mycologist on the 20th September, 1926.

Travelling.

During the above period I was absent from Nairobi on duty for 32 days. About 2,850 miles were covered on Government service and 63 visits were made to European farms and about 30 to those of Indians. In January and December Nakuru was visited in connection with the two Agricultural Shows. Further sugar cane mosaic disease surveys were carried out in the Nyanza Province in March and October.

Several visits to different parts of the Kyambu and Fort Hall Native Reserves were made at various times to make field observations of streak disease of maize.

During the holding of the Intercolonial Agricultural Conference, visiting delegates were taken to Thika, Kyambu and Limuru in accordance with the Conference programme.

Correspondence.

Inward letters numbered 542, outward letters 387. In addition 63 circulars connected with sugar cane mosaic disease were sent to individual farmers.

Altogether a range of 22 different hosts was covered.

Letters asking for information about crop diseases were also received from India, Tanganyika Territory, and Southern Rhodesia. On the other hand valuable information was received from other countries, notably South Africa, a number of whose officials have rendered considerable assistance during the present year.

The services rendered by the Imperial Bureau of Mycology have been most valuable, especially in identifying plants and fungi and in advising on methods of disease eradication.

Investigational Work.

In March and October further inspections of European and native sugar plantations for mosaic disease were carried out, with the result that slight infections were found in the Kibos area which had been previously thought to be free from this disease. A careful inspection of the canes on the

ex-Government farm again failed to show any trace of mosaic disease and none has yet been found within two miles of this farm. As far as is known sugar cane mosaic is still confined to the Nyanza Province.

So far, even in badly infected cane fields, no signs of mosaic have been found upon grasses. This of course is only negative evidence for mosaic may be present. I would here like to express my appreciation of the valuable assistance rendered by Mr. C. G. Hansford, M.A., recently appointed Mycologist in Uganda, who accompanied me on a tour of inspection in the Nyanza Province during October.

Careful attention has been given to the problem of complete eradication of sugar cane mosaic disease from Kenya. Of the sugar grown in Nyanza Province, most is of the generally accepted immune Uba variety, while nearly all the remainder is a soft, striped ribbon cane known locally as "Kampala." This latter is not immune to mosaic disease, but is highly tolerant of it, that is to say the effect of the disease on this variety appears to be very small, in fact almost negligible. Nevertheless it is known that mosaic disease is readily transmissible from such tolerant canes to other non-immune varieties and, as long as the disease exists in Kampala cane, it may be impossible to grow profitably in its vicinity susceptible varieties which for any reason it might be desirable to introduce. Hence, in the interests of the growing sugar industry of Kenya, it has been considered advisable to make a bold attempt at complete eradication of the moisaic disease. To this end a Government Notice has been gazetted prohibiting the growing of any cane other than the Uba variety, in a scheduled area of the Nyanza Province, for a period of two years from the 1st June, 1928. It is considered that the intervening period will allow ample opportunity for farmers to renew their present canes of non-immune varieties, without inflicting appreciable hardship. However, it must be admitted that there are loopholes in the present quarantine system. The chief of these is that the system takes no account of the other host plants of mosaic. Maize is grown extensively in this same area and we know that maize is a host of the mosaic though we are not aware that maize in this district is at present affected. If only an occasional maize or grass plant becomes infected it may be sufficient to allow of the carrying over of the disease through the period of quarantine.

While fully aware of the loopholes in this quarantine system under the present conditions, such as close proximity to extensive native reserves, in which sugar and maize are grown as food crops, it is considered the very best that could be devised capable of being administered with the present paucity of staff.

In conjunction with the Assistant Entomologist, a considerable number of field observations have been carried out in connection with streak disease newly reported on maize last year. It was hoped that this disease (which is of the virus type and is in many ways similar to mosaic disease of sugar) would not prove of importance in Kenya. As far as the chief European maize growing areas are concerned there still appear to be grounds for this hope, but in parts of the Kikuyu Reserve the disease is doing considerable damage. In Natal the disease has been shown to be transmissible by the agency of a leaf-hopper, but, to date, the particular species has not been found in Kenya. A number of laboratory experiments, carried out with various species of leaf-hoppers found in affected maize, have not so far succeeded in transmitting streak disease to healthy plants.

During August Mr. Ritchie, Entomologist, Tanganyika Territory, and the Inspector of Plantations, found streak disease on Uba cane at Ruiru, this being the first record of streak disease on sugar cane in Kenya.

The seedling disease of coffee previously reported has recently been found in a second coffee nursery in Kyambu district, and, also quite recently, a similar disease, possibly identical, has been found on podocarpus seedlings at Elburgon. During the year successful inoculations on coffee seedlings have been obtained with the fungus (*Rhizoctonia solani* Kuehn) isolated from diseased coffee seedlings, and particularly successful results have been obtained with the strain isolated from strawberry roots. The fungus is, therefore, considered definitely to be the cause of the coffee seedling disease but much remains to be done to ascertain the precise conditions which favour the infection. Experiments are also in hand to discover the best means of eradicating the disease from the nursery beds.

In collaboration with the Agricultural Chemist manurial experiments were commenced in 1925 with the primary object of discovering if certain manures were likely to assist coffee bushes to resist berry disease. Unfortunately a severe attack by a leaf-eating caterpillar (no specimens forwarded) was experienced and almost complete defoliation of the bushes took place, which entirely negatived any results which might otherwise have been obtained.

An interesting observation was communicated by the owner of this same estate. He states: "Most varieties of 'bronze tipped' coffee appears to be resistant to berry disease." This would rather indicate a fruitful line of research by carrying out breeding experiments.

The new disease of peas mentioned in the Report for 1925 has also been further investigated. The disease has been produced successfully by laboratory inoculations but the causative fungus has not yet been precisely determined.

A specimen of *gliricidia maculata*, a tree with which the Senior Coffee Officer is experimenting as a possible shade for coffee, was found to be affected, at the Scott Agricultural Laboratories, with a disease of the anthracnose type. As it was considered that the question of the susceptibility of this tree to disease might be of importance to the coffee industry, an investigation was begun. A species of *colletotrichum* was isolated from a diseased limb and inoculations were made with this fungus. In a few cases small lesions were produced as a result, but these have not shown much tendency to attain the size of those produced naturally. This may be because the latter occurred while the rainy season was in progress, whereas the artificial inoculations could not be carried out until the drier weather had set in.

A species of *cercbella* was found parasitizing the ears of an accidental plant of rye which appeared in a plot of Cedar wheat, the seed of which had been imported from Australia. Although this genus has done little damage in Kenya, it is already known to occur on mtama (Sorghum), broom corn and the indigenous grass *cynodon dactylon*. It may, therefore, be a potential disease of cultivated graminaceous crops and, as opportunity has arisen, studies of the species of the genus from the different hosts have been pursued in the laboratory.

The experiments, begun last year, in which a series of fabrics, received from the Department of Scientific and Industrial Research, were exposed to various climatic influences, were brought to a close in February and the fabrics returned to England, together with numerous data which had been collected in connection with the exposures.

During the past season, which in many districts has been an unusually wet one, farmers have suffered considerable loss due to the attack on maize of a species of *fusarium* which is believed to be a stage in the life history of *gibberella saubinetti* Sacc. This loss, which in many cases amounted to as much as 50 per cent. of individual crops, has been caused by an attack of the fungus on the heads alone. There is little doubt that the wet and cloudy weather which alternated with the hot and clear weather at the time of flowering and throughout the ripening period of the maize during the past season has been one of the chief factors in the development and spread of this disease. Under these unusual weather conditions the fungus appears to spread very rapidly and affects individual cobs to such an extent that they are not worth harvesting. Seedling disease of maize produced by this same fungus in other countries has not yet been reported from any part of Kenya. It may be present in the country though so far not proving sufficiently serious to attract attention. The disease commonly known as "Glume Blotch" of wheat and caused by the fungus *septoria nodorum* Berk. (Synon. *Macrophoma hennebergii*) is to be reported

for the first time in Kenya Colony. During the past season this disease has shown itself in most districts where wheat was being grown but only at the higher altitudes has it caused extensive damage. At these higher altitudes glume infection was present to such an extent that the heads of wheat produced shrivelled seeds and yields were considerably reduced. It is considered that the unfavourable weather conditions of the past season have been the chief cause of the present serious infestation.

Routine Work.

In January and December exhibits showing the chief diseases of the crops of the country were prepared and staged at the Nakuru Shows.

The official visits to plantations and the Annual General Meeting of the Coffee Planters' Union were attended in March, for the purpose of supplying mycological information when requested.

An examination in theoretical and practical botany was held in July on behalf of the Pharmacy Board.

In August the meetings of the inter-Colonial Agricultural Conference were attended. Papers were prepared and read and contributions were made to various discussions.

A number of indigenous plants have been collected during the year and forwarded to the Royal Botanic Gardens, Kew, for naming.

Inspections of plants and seeds, imported by parcels post, have been made at the General Post Office, Nairobi, whenever required.

General Observations.

The following diseases and fungi were noted or definitely identified for the first time in Kenya during the year :—

Sugar cane—Streak disease.

Apple and pear—On stems : *Sclerosphoma mali* (Brun.) Syd.

Cow pea—Leaf spot : *Septoria* sp. near S. *glycines* Hemmi.

Cow pea—*Woroninella dolichi* (Cke.) Syd.

Acacia melanoxylon—Nectria flavo-lanata B. and Br.

Acacia melanoxylon—Polystictus occidentalis Klotzsch.

Podocarpus gracilior—Seedling disease. *Rhizoctonia* sp.

Warburgia Ugandensis (Roof Bean). *Poria* sp.

Bullrush Millet (*Pennisetum typhoideum.*)—Rust. *Puccinia penniseti* Zimm.

Pennisetum cenchroides—Rich. Rust. *Puccinia* sp. probably *P. Penniseti* Zimm.

Tricholæna rosea Nees—Rust. *Puccinia levis* (Sacc. and Bizz.). Magn. (?)

Wild Clover (*Trifolium* sp.)—Rust. *Æcidium* sp.

Hibiscus diversififolius Jacq.—Leaf Spot. *Phomopsis* died (?) *Malvacearum* West.

Sesbania—Dead twig. *Cyphella villosa* (Pers.) Karst.

On dead log—*Ganoderma applanatum* (Pers.) Bres.

On soil—Termite nest fungus. *Xylaria nigripes* Klotzsch.

Wheat—*Septoria nodorum* Berk. (Synon. *Macrophoma hennebergii* Kuhn.)

Cedar (*Juniperus procera*)—*Ceratostoma juniperinum* Ell. and Ev. producing galls.

Brachiaria brizantha Stapf—(*a*) Rust. Uredo form sp. (?) (*b*) Black spot on leaves, *Phyllachora* sp. (?) probbably *P. heterospora* Henn.

Rye—*Cerebella sorghi-vulgaris* Subram.

Cynodon dactylon. Fusarium heterosporum Nees.

Setaria Aurea A. and Br. *Beniowskia penniseti* Wakef.

The only newly reported diseases of importance are "Glume Blotch" of wheat and streak of sugar cane.

Streak was found in maize last year and, as previously mentioned, is having serious effects on that host in parts of the Kikuyu Reserve. The Natal experience, however, is that sugar cane does not suffer so severely from streak as it does from mosaic disease. Losses estimated at 10 per cent. are, however, known to occur in some seasons in Natal.

H. WILKINSON,
Acting Mycologist.

APPENDIX H.

Report of Plant Breeder.

I have the honour herewith to submit my report for the year February 1st, 1926, to January 31st. 1927. I have chosen these dates for the limits of my annual report as they approximate much more closely to the beginning and end of the wheat year than do the dates of the calendar year, and it is thus possible to give the beginning and end of an experiment of one year in one report instead of stating the first part of an experiment in one report and the remainder in another report. This new method will make for much greater clarity in reports of experiments than did the old method.

Staff.

I was absent on leave until July 2nd, during which time, and also from August 15th until the end of 1925, my duties were carried out by Mr. E. Harrison, Deputy Director of Agriculture, assisted by my Junior Clerk, Mr. R. N. Noble.

Visit of Sir Rowland Biffen, F.R.S.

Sir Rowland Biffen was invited by Government to visit this Colony and report on the methods adopted and the progress made towards the improvement of the wheat crop, as well as on the potentialities of the Colony as regards wheat. In order that he might gain a right impression of the country he undertook an extensive tour of the wheat areas, where he found most of the wheat crops in the most interesting stage of their growth. He was piloted round the country chiefly by myself, but also by Mr. P. Booth, Agricultural Department, and Mr. W. Evans.

The districts Sir Rowland visited were Machakos, Nanyuki, Upper Gilgil and Thomson's Falls, Mau, Narok, Njoro, Mau Summit, Londiani, Timboroa, Plateau and the Trans Nzoia. Meetings were held with settlers in all districts visited so that they might have an opportunity of airing their views on the wheat industry. Unga, Ltd., and the Kenya Grain Mills were both visited. It is hoped as a result of Sir Rowland Biffen's report that the work of the Plant Breeding Section will become more centralised and more concentrated in a wheat area and that the three breeding stations will be near each other, thus enabling the experimental wheats to be under closer and more frequent observation than is possible with the present organisation. Centralization of the work, more staff and greater expenditure of money is of the utmost importance if the best results are to be obtained from the work of the Plant Breeding Station.

Travelling.

A considerable amount of travelling has been done in order to sow, examine and harvest experimental wheat plots, and in touring round the districts examining wheat crops for diseases and suitability to conditions, etc. The travelling of my section is bound to be somewhat extensive on account of the widely scattered and different, but all equally important, wheat districts of the Colony.

Correspondence.

A considerable quantity of correspondence was dealt with on all subjects relating to wheat.

Lectures.

Informal addresses on wheat in this country, with particular reference to the problems of the particular district concerned, were held at Nanyuki (lecture given by Mr. P. Booth, Senior Agricultural Supervisor), Upper Gilgil, Londiani, Eldoret and Kitale. The questions asked and answers given, together with the views expressed by members of the audience proved, I think, of great value to all present, and it is hoped that one result, at any rate, of these meetings has been to give farmers a better idea than they had as to the appearance of the three rusts, so that I may be better informed in future as to the incidence of rust on the wheat crops of the Colony. Furthermore, I think farmers in general have a better idea now than in the past as to what are the safest varieties of wheat to grow in their districts.

Experimental and Breeding Work.

Scott Agricultural Laboratories.

Here some 85,000 grains of hybrid origin were sown at the end of March, 1926. These were the constituents of some 384 cultures or families. A family in this case is the progeny of a single plant harvested from a family the previous year. Of these 384 families, 70 were pure for immunity or high resistance to black stem rust, though they were not all pure for all other characters of the wheat plant. Many other families were pure for susceptibility to black stem rust, and many more again were still splitting up for resistance and non-resitance to black stem rust. Not by any means all of the cultures were suitable for field conditions. 156 of the families were harvested in August and September, 1926. Many of these were susceptible to black stem rust but, on account of their excellent qualities, were harvested in order to be sown in 1927 at Mau Summit, where they will undergo trials for resistance to yellow rust.

The last remaining 23 " Kabete " varieties were sown for trial in triple rod-rows in triplicate and at harvest all were thrown away. I am glad to be able to inform you that all the original 650 or so of " Kabete " and imported varieties.

except that now named " Kenya Governor," have at last been discarded as being not good enough for conditions of rust such as obtain at the Scott Agricultural Laboratories.

During the short rain season, beginning in November, 16 new rather similar hybrid varieties were grown in hand-sown plots in quadruplicates. These same varieties were also sown in multiplication plots. Over one hundred other new hybrid cultures, of very similar character to the former, were also hand sown. It is hoped to transfer most of these to a breeding station at Mau Summit in 1927 to test them for resistance to yellow rust, as none of them, with the possible exception of one, showed sufficient resistance to black stem rust during either the long or short rain season of 1926 for growing at low altitudes; but they appear to belong to an exceptionally fine yielding type of wheat and very well suited to the conditions of this country.

Njoro. (*Lord Egerton of Tatton's Farm.*)

Some 13,000 grains of hybrid origin were sown here. These were the constituents of some 148 families. Of these 148 families 48 were pure for immunity or high resistance, both to black stem rust and yellow rust, though they were not all pure for all other characteristic of the wheat plant. Other families were pure for susceptibility to black stem rust but resistance to yellow rust and others pure for susceptibility to yellow rust and resistance to black stem rust, some of these of course were impure for other characters. Other families were again impure for everything as the characters are still segregating, but it is expected eventually to find useful material among them. 83 of the Njoro cultures were harvested in January, 1927, for further trial.

In addition to the hybrid wheats as above, the twenty-three remaining pure-line " Njoro " varieties were sown in triple rod-rows in triplicate for yield and rust trial. Thirteen of these were the remainder of some single plant selections made from " Bobs Rietti " several years ago. Several others were selections from an American cross of " Marquis X Lumillo." These twenty-three varieties had heretofore shown very high resistance both to black stem rust and yellow rust, but this season, owing to a succession of adverse circumstances, the plants were all very weak, thin, unhealthy and small, and all varieties were severely attacked by black stem rust, excepting " Kenya Governor," which was only slightly attacked. In my opinion it is possible that these plants in their weakened condition has failed to form that " property " which gives them resistance to black stem rust, which " property " they build up in their system under normal and healthy conditions of growth. In this connection it is frequently observed that young late shoots of any rust-resistant plant often show pustules of rust when the main stems are completely free, and experience leads me to believe

PLATE 5.

Kenya Governor Wheat at Scott Agricultural Laboratories.

that plants whose main stems are completely free from rust, but whose young shoots are not, are not to be guaranteed as rust-resisters, whereas I delight in finding plants both whose main stems and young shoots are completely free from rust as I regard that almost as a guarantee that the plant is immune. To revert, however, to the 23 varieties. These have all now been discarded for Njoro, both on account of their breakdown this year (which may have been due to an inherent susceptibility which might have become more manifest under field conditions), and because I believe we are in possession of more resistant varieties.

This is not the only case I have seen in which rust resistant plants in an unhealthy state have shown more susceptibility than when healthily grown, and I regard it as a point worth bringing to the notice of wheat growers that it is both probable and possible that a healthy wheat crop whose healthiness is due to good cultivation and a sufficient supply in the soil of all the ingredients the plant requires, is, if physiologically resistant at all to rust by nature, likely to be more resistant to rust than an unhealthy crop. The susceptibility to rust of an excessively luscious crop owing to an excessive supply of nitrogen is due to quite another reason.

Upper Gilgil. (*Mr. Patten's Farm.*)

Here the same 23 varieties as at Njoro were sown in triple rod-rows in triplicate for yield and rust trial. Furthermore these same varieties were also sown in multiplication plots. Nine of the varieties were highly resistant to yellow rust, and all the rest except one were quite fairly resistant. None of the varieties showed any signs of black stem rust. 17 of the varieties have been harvested, of which 9 have been handed over to Mr. Patten for further experiment and multiplication by him. 8 have been retained by the plant breeding section for further experiment and multiplication at Mau Summit. Kenya Governor showed no signs of yellow rust at all, and yet last year I am given to understand that it was practically destroyed by yellow rust. This is merely an example to show over how many years it is necessary to test a variety for resistance to any rust.

Londiani. (*Mr. J. R. S. Stuart's Farm*).—Here eight varieties were sown as a rust trial. Some of them look promising.

N.B. 214. *A.8.* was free from both black stem rust and yellow rust.

Equator was free from yellow rust, but showed very slight signs of black stem rust.

Kenya Governor had neither black stem rust nor yellow rust, but a rogue in it had black stem rust.

Droop No. 3 showed traces of yellow rust and the late tillers only were infected by black stem rust.

N.B. 23 *A.* (*L.*1.) was infected with yellow rust but not with black stem rust.

N.B. 24 *C.* (*L.*1.) had no yellow rust and only the late tillers had black stem rust.

N.B. 230. *A.* 22. (*L.*) had no yellow rust, but was slightly infected with black stem rust.

N.B. 21. *A.*1. (*L.B.*) was infected slightly with black stem rust, but not with yellow rust.

The behaviour of some of these wheats towards rust in other parts of the country will be given later on in this report. Some of them are destined for growing at high altitudes and some are used as black stem rust testing wheats.

Trans Nzoia.

During 1925 there was a severe epidemic of rust in the Trans Nzoia. All varieties were destroyed or seriously affected by black stem rust. This was rather extraordinary as I had hardly ever seen any signs of black stem rust in the Trans Nzoia until I sowed some multiplication plots of several varieties on Elgon Downs Estate early in 1925. A crop of Cross XI was being grown in 1925 on Sabwani Estate, Kitale Plains. Cross XI is a mixture of varieties. It was observed that although Cross XI as a whole was being completely destroyed by rust yet there was a bearded variety in it which was completely free from rust. Mr. E. Harrison, Deputy Director of Agriculture, assisted by Mr. G. M. Hamilton, Flax Officer, immediately started to select out these plants. About 11,000 plants were pulled out by the roots and ripened off in trenches. These plants were then separately threshed out.

In 1926 the progeny of several thousands of these plants were sown out by Mr. Leach at Chorlim Estate, Mount Elgon, in separate rows in order to keep the pure-lines going. The remainder of these plants were bulked together and sown on two acres of land at Sabwani Estate. I examined the pure lines at Chorlim Estate and found them all free from black stem rust, but my assistant, who went through the plots at greater length a week later, found very slight signs of black stem rust scattered here and there amongst the plots. Some thirty selections of the pure-lines were made. Nearly all were fully bearded and were severely infected with orange leaf rust. There was, however, one pure-line of a tip-bearded, brown-chaffed type which was completely immune to orange leaf rust. This pure-line is going to be very useful to me to cross with other pure-lines of mine which are already immune both to black stem rust and yellow rust, and so produce a wheat immune to all three rusts in the Colony.

Besides this two acres of the new wheat grown at Sabwani this year, some ordinary Cross XI was also sown next door to the new variety. Bundles of each have been

sent to me. The new wheat shows no signs of black stem rust. The Cross XI has been slightly attacked by black stem rust, but the bearded wheat in it is completely free from black stem rust. It would appear that one new variety highly resistant to black stem rust and another highly resistant both to black stem rust and orange leaf rust has been found for the Trans Nzoia, or at any rate for one district in the Trans Nzoia.

At the risk of making this report too long, I must make a few remarks about Cross XI in the Trans Nzoia and other districts. I have studied Cross XI for several years and the following are the results of my experiments in all districts except the Plateau and Trans Nzoia. Cross XI is completely destroyed by black stem rust at all altitudes of about 7,500 feet and below. The bearded and beardless varieties are the first to succumb. Certain white-chaffed, tip-bearded varieties are more resistant than the bearded and beardless varieties but in a severe rust epidemic (which is our common experience now-a-days) these tip-bearded varieties are destroyed. The tip-bearded brown chaffed type is not quite so resistant as the other tip-bearded types, but far more so than the bearded and beardless types. The sort of resistance possessed by the tip-bearded types is sufficient to give high resistance in certain seasons but not sufficient to prevent destruction in other seasons.

Equator wheat is also destroyed by black stem rust at all altitudes of about 7,000 feet and below except in the Trans Nzoia and Plateau.

It would appear the behaviour towards rust of certain varieties of wheat is different in the Trans Nzoia from in other districts. The varieties of wheat in question are mainly Equator and Cross XI. Equator seems so far never so seriously attacked by black stem rust in the Trans Nzoia and Plateau as it is elsewhere. The fully bearded type in Cross XI is apparently practically immune to black stem rust in the Trans Nzoia whereas it is one of the most susceptible types in other parts of the country. It may be that some of the strains of black stem rust in the Trans Nzoia are different from those in other parts of the country, or that soil properties and climatic conditions in the Trans Nzoia may be different from those in other parts of the country and cause a difference in the resistant property of the wheat plant, or, in the case of Cross XI, that the bearded type (which takes longer to mature than the rest of the variety) has been in the state of its highest resistance when the attacks of rust came along, whereas the rest of the variety was in a state of great susceptibility. Some strains of black stem rust in the Trans Nzoia must be the same as in other parts of the country, as some varieties of wheat are equally susceptible to black stem rust in the Trans Nzoia and elsewhere. The bearded type in

Cross XI has apparently been immune to black stem rust on Kitale Plains for two seasons now, so it looks as if it has acquired resistance there rather than merely escaped rust.

The whole question of black stem rust in the Trans Nzoia must be approached with caution. Black stem rust did not appear there until 1925. Any year now, conditions may become the same as in other parts of the country. The pure-lines of wheat at Chorlim Estate did not undergo a real test for black stem rust but only for orange leaf rust, whereas the bearded type on Sabwani Estate did undergo a good test for black stem rust. I would recommend that this bearded type of wheat culled from Cross XI be called " Sabwani " wheat, that it be multiplied on Sabwani Estate and that, when it is in sufficient quantity, it be distributed only amongst those farms on Kitale Plains which have similar soil to Sabwani Estate and amongst the farms on Mount Elgon itself. I would not recommend its distribution elsewhere in the Trans Nzoia until exhaustive trials have been made of its resistance to black stem rust in other parts of the Trans Nzoia in comparison, of course, with the resistance of other varieties. Unfortunately it is becoming increasingly apparent that work of this nature cannot be undertaken by the plant breeding section unless both the staff and the travelling allowance thereof be augmented. The brown-chaffed tip-bearded pure-line grown on Chorlim Estate should be multiplied on Chorlim Estate, tested out and, if found of any use, called " Chorlim " wheat.

General Observations and Remarks.

(1) *On Rusts.*

Important data on the distribution of rust have been obtained this year. Severe attacks of black stem rust have been seen as high as 8,500 feet in the Thomson's Falls area on a Pusa wheat. A moderate attack of black stem rust has been seen as high as 9,500 feet in the Mau Narok area on Marquis wheat. A slight attack of yellow rust has been seen as low as 6,600 feet in the Nakuru area. There is no doubt that black stem rust is becoming established in the colder and higher levels of the country, however, Equator wheat still seems able to withstand it at the higher levels though it cannot at the lower levels. Black stem rust is a more dangerous disease than yellow rust. This does not mean to say that yellow rust will not destroy a crop of wheat. It will, but the epidemics appear to be less frequent and less sweeping than do those of black stem rust. Orange leaf rust is still very prevalent, and must undoubtedly slightly affect the yield of wheat. As already indicated it is hoped to overcome this rust by breeding.

Examples showing how rust has been attacking wheat this year will be of interest.

In the Trans Nzoia on Kitale Plains Equator was completely free from black stem rust, though a bearded rogue in it was badly attacked. " Marquis " was severely attacked by black stem rust.

(*N.B.*—At the Scott Agricultural Laboratories and in the Nakuru and Njoro areas " Marquis " and " Equator " are always equally badly infected by black stem rust). " Droop No. 3 " was badly attacked by black stem rust, and another fully bearded rogue was as severely attacked as was the " Droop No. 3." (*N.B.*—These bearded rogues come from either Cross XI or Cross 13/5. One might have been from Cross XI and the other from Cross 13/5).

A very resistant wheat called N.B. 24 C. (L.1.) was as severely attacked by black stem rust as was " Droop No. 3," whereas a wheat called N.B. 23 A. (L.1), which is not quite so resistant as N.B. 24 C. (L.1), was completely free from black stem rust, and yet last year N.B. 23 A. (L.1) was very badly rusted. " Kenya Governor " only showed the very slightest signs of black stem rust. Last year both " Kenya Governor " and " Equator " were seriously attacked by black stem rust, though I am told that the 1½ acres of " Kenya Governor " sown yielded six bags.

On the Plateau, " Equator " was generally fairly free from black stem rust. " Droop " was destroyed by black stem rust at 7,000 feet near the Elgeyo Border; in the same district " Marquis " was free from black stem rust. " Burbank's Quality " wheat was severely attacked by black stem rust and moderately attacked by yellow rust at 7,000 feet. A wheat called " von Lettow," though a magnificent looking and strong growing wheat, was seriously infected with black stem rust. " Golden Ball " and " Groot Korn " were fairly free of black stem rust.

In the Burnt Forest, " Equator," " Marquis " and " Bobs Rietti " were fairly free from black stem rust. " Burbank's Quality " wheat was seriously attacked by black stem rust. There were signs of yellow rust in " Marquis."

In the Londiani area, " Marquis " and " Equator " were fairly free from black stem rust, as also was " Kenya Governor." There were no signs of yellow rust except on a fully bearded rogue growing near some " Kenya Governor." This rogue plant was covered in yellow rust.

In the Njoro and Nakuru areas, practically all the fields of " Droop " and " Cross XI " were completely destroyed by black stem rust. In every case except two, " Kenya Governor " was almost completely free from black stem rust and fields of it gave yields of up to eight bags per acre. Of the two exceptions, one crop was fairly badly attacked by black stem rust all through from the flowering stage to harvest, but

the grain and yield seemed unaffected. The other crop I never saw. I am told that it was practically destroyed by black stem rust. I have written for a first-hand account from the grower but no reply has been received.

There were slight signs of yellow rust on " Kenya Governor." I am told that last year it was smothered in yellow rust. " Golden Ball " and " Groot Korn " were seriously attacked by black stem rust. It has obviously been a severe rust season in the Nakuru and Njoro areas.

In the Thomson's Falls and Upper Gilgil area, at 8,000 to 9,000 feet, a Pusa wheat was seriously attacked by black stem rust, though I believe the grain was unaffected. " Marquis," " Equator " and " Cross XI " were free from black stem rust. " Cross XI " showed signs of yellow rust and " Marquis " was fairly seriously attacked by it.

At very high altitudes such as Mau and Molo, " Equator " is fairly free from black stem rust and immune to yellow rust. " Marquis " is moderately attacked by both. " Florence " is fairly free from both black stem rust and yellow rust.

At Machakos, " Droop " was destroyed by black stem rust, whereas " Kenya Governor " has been almost completely free from it. Experimental plots of N.B. 23. A. (L.1), N.B. 24. C. (L.1), " Droop No. 3 " and " Kenya Governor " were all slightly attacked by black stem rust. The first three are decidedly more susceptible than " Kenya Governor." This is another example showing how many seasons are required to show the comparative resistance of different varieties. During the short rain season at Machakos " Droop " has been destroyed by drought, whereas " Kenya Governor " is yielding well. " Kenya Governor " is apparently drought resistant. During the long rains season of 1926 a yield averaging eleven bags to the acre was obtained from two hundred acres of " Kenya Governor " at Kilima Kiu.

A general summary of the experience of this and previous years indicates that " Equator " is the only wheat immune to yellow rust and that " Kenya Governor " is the wheat most resistant to black stem rust. My recommendations to wheat growers are that, at high altitudes where yellow rust is the chief danger and where black stem rust may become a danger, they should grow " Equator," which has, so far, been fairly safe from black stem rust at high altitudes. " Equator " takes a long time to mature, and as a subsidiary wheat they might grow the short maturing " Florence," which shows a fair resistance to yellow rust though it is susceptible to black stem rust. At low altitudes where black stem rust is the only danger, they should grow " Kenya Governor " only. The one exception to this is the district round Mount Elgon where " Equator " can possibly be grown with nearly as much safety as " Kenya Governor." At medium altitudes black stem rust

is a greater danger than yellow rust and here I would recommend " Kenya Governor," as I do not think that yellow rust will be a destructive force every year. In the Burnt Forest area a mixture of varieties called " Bobs Rietti " has been grown with success for many yeass, but I would not recommend this wheat for general cultivation. " Equator " is also a success in the Burnt Forest. I should point out that the differences in the incidence of rust at the different altitudes is probably caused by climate. Thus a medium altitude with a warm climate might come into the category of a low altitude. Low altitudes are from 4,500 feet to 6,500 feet, medium altitudes are from 6,500 feet to about 7,500 feet, high altitudes are from about 7,500 feet to 10,000 feet.

Macrophoma.

A Macrophoma fungus has appeared on wheat, probably for the first time, this year. This disease appears in black spots on the chaff and, in extreme cases, in dark longtitudinal markings on the stem. It is to be seen soon after the wheat has flowered and after a short time gives the ears the appearance of having ripened off, prematurely of course, whilst the rest of the plant is quite green. In some cases no grain at all is formed, in others any grain that has formed is shrivelled up, as the ears dry up when attacked by the fungus. This disease has been most destructive on the Plateau, but it has occurred throughout most of the country, particularly in the colder and wetter parts. Many wheat fields have been completely wiped out by it. On the Plateau the crops that most generally suffered were those which were planted in April. After that there was a six weeks' drought, followed by incessant cold and wet. It is interesting to note that wheat growing in the hollows between ant-hills suffered more than wheat on the tops of the ant-hills ,also that wheat sheltered by wind-breaks was more severely attacked than was unsheltered wheat. In my opinion Macrophoma is not a pest such as is rust, that is to say it will not occur year after year, but only in those years when climatic conditions approximate to the conditions of this year. The climatic conditions of this year have been characterised by extreme cold and wet throughout the day as well as the night and by an absence of sun. I feel sure that the disease has been due to coldness, wetness and absence of sun. Had there been an adequate amount of sun, the coldness and wetness alone would not have brought on the disease. Good cultivation should help to control the disease by inducing strong plant growth.

Smut.

Loose smut of wheat has been more in evidence this year than previously. The variety of wheat most affected is " Equator." The disease is likely to spread unless steps are taken to control it. In future farmers should treat their seed by the " hot water " method before sowing—their " Equator "

seed in particular—or else only use seed that is known to be clean. Loose smut looks like a growth of soot on the bare rachis of the wheat ear.

Manures.

A large measure of success has followed the use of phosphatic manures this year. The results in some cases have been startling. Phosphatic manures appear to give most benefit on the light soils of the country, particularly on the pale red soils found chiefly on the higher levels. Farmers should experiment with the different phosphatic manures to find out which suits their soils best. A hundredweight of guano to the acre has been found to have a very beneficial effect. Vegetative growth of wheat on the light soils of the country is poor and in such cases green manures would undoubtedly have a good effect on the succeeding wheat crop. Here again farmers should experiment with the different green manures to see which grow best and most rapidly under their conditions of soil and climate.

General Remarks on the Cultivation of Wheat.

In the light of the experience of this and previous years it is obvious to me that the lands are not, generally speaking, well enough cultivated or sufficiently well manured to yield the best possible crop of wheat. The lands I mainly refer to are the lighter lands of the Colony and these are in the majority. These lands are, in themselves—granted that climatic conditions are right—better suited to maize than to wheat, but I am convinced that with proper cultivation and manuring they can give very satisfactory results with the latter crop. It is urged that wheat be given a fair chance on them as this crop is likely to be a better paying one than maize, and, even if this be not so, a rotation of crops would appear advisable. On the lighter lands it is important to form a firm and deep seed bed. To effect this plough deep and later on use a disc harrow and/or a roller before sowing; after sowing, when the wheat is four to six inches up, and if climatic conditions allow, a roller followed by a harrow should be used to conserve moisture, firm the seed bed, assist tillering and strengthen the growth. The light soils seem to be in need of phosphatic manures and these should be supplied; furthermore they are lacking in humus which gives body to the soil, aerates it and binds it together. Owing to the farming conditions of this country, humus can only be added to the soils by means of a green manure, and this should be done. A further point is that wheat is sometimes sown too thinly, too much reliance being placed on its tillering powers. Thin sowing coupled with a prolonged rainfall tends to excessive tillering which, apart from not giving the best possible yield, causes uneven ripening and a consequent difficulty in harvesting. Late tillers and excessive side tillers do not produce the best ears and those tillers which produce small ears or no ears at all merely extract food from the soil

without giving any adequate return. The whole object in sowing wheat should be to fill the area with the largest possible number of the best ears. It will probably be found that about an average of two stalks per plant is the ideal. I feel sure that a closely packed mass of ears, twelve spikelets of which have set two grains apiece, will yield better than a loosely packed mass of ears sixteen spikelets of which have set two grains apiece. In this latter case there would be many ears which set little or no grain at all and which are simply wasting soil food. Rate of sowing varies with the class of soil and with the variety of wheat, and farmers should experiment with rates of sowing (and some of them are doing so) and find that rate which gives the largest number of good ears per acre. A slightly too thick rate of sowing gives a large number of plants per acre but may just prevent the plants tillering at all, which would considerably lower the number of ears per acre. Only ten pounds less seed per acre might just allow the plants to tiller adequately and thus nearly double the number of ears per acre. Cultivation after the crop is up will be found to assist tillering, particularly in a thickly sown crop. I must urge upon farmers that, to grow high yielding crops and to minimise the results of attacks by fungoid and insect pests, their wheat lands should be well cultivated and well manured so that the crop may grow strongly and healthily and find in the soil all those constituents from which it forms its disease resisting properties.

It is feared that 1926 has not been a particularly good year for wheat in many parts of the country on account of the wholesale destruction of crops by rust and Macrophoma.

Maize Breeding.

Very little work has been done on the improvement of maize this year. This is largely due to the distance the maize fields are from the plant breeding headquarters. Some assistance has been given to Mr. Cranswick, Mr. Oakes and the Honourable Director of Agriculture in the selection of plants from their breeding plots.

Plant Breeding Organisation.

It is important to note that out of the 156 cultures harvested at the Scott Agricultural Laboratories this year, 132 were harvested after August 20th, and 97 of these were harvested after August 27th. The progeny of the cultures which were not ready for harvest until after August 20th, or at any rate after August 27th, should not be grown at the Scott Agricultural Laboratories but should be transferred to some low altitude district such as the Rongai Valley, where the season is more prolonged. The Scott Agricultural Laboratories with its short rainy season extending usually from the end of March to the middle of May is only suitable as a place for growing, at the longest, 4½-months wheats. Wheats which take longer than that to mature are not given a fair chance in competition with short maturing wheats. They

are likely to be discarded on account of poor grain and poor yield, though it is not their fault. (Thousands of plants have to be discarded every year in order to keep the work within bounds and two of the points taken into consideration are, of course, quality of grain and yielding capacity). There is little doubt that these long maturing wheats would take still longer to mature were they grown under natural conditions. When the cultures are small they can be irrigated as soon as the rains cease, but that is not too satisfactory a way of dealing with the problem. When the cultures reach the variety stage and comparative yields are under consideration, then irrigation is most unsatisfactory, and is of course impossible at the Scott Agricultural Laboratories if and when a large acreage of wheat is grown. In spite of the exceptionally long rainy season of 1926 it was still found necessary to water the long maturing wheats in order to get them to yield anything at all, and owing to the scarcity of water it was with the greatest difficulty that they were brought through at all, and of course they by no means did themselves justice. If the long maturing wheats, and these are in the majority, are transferred to their natural habitat in such a place as the Rongai Valley then there would be two low altitude stations for breeding wheats resistant to black stem rust, namely, Scott Agricultural Laboratories and Rongai Valley. This would at least treble the work of breeding wheats for resistance to black stem rust. The logical thing to do is to put both the long maturing and short wheats in a district such as the Rongai Valley, which is suitable for both. This would concentrate the work on black stem rust. Furthermore, at Njoro is located the station for breeding wheats resistant both to black stem rust and yellow rust. Njoro and Rongai Valley are close together in one district. If these were the two main breeding stations then would be achieved that centralization and concertration of work which is so essential for successful plant breeding. To know the characters of the thousands of hybrid wheats properly, one must see them in all stages of growth and be in the closest contact with them throughout. This is impossible if the breeding stations are a hundred miles from each other. There is little doubt that this scattered organisation is what has been largely responsible for the errors and losses that have occurred in the past, and which have so seriously retarded the wheat breeding work. I am never in proper touch with wheats at the Njoro breeding station; the Deputy Director of Agriculture experienced the same difficulty when he was doing my work during my absence on leave, so much so that, after only six months' of plant breeding, he advocated in his annual report for 1925 the establishment of a wheat and maize breeding station in the Nakuru area.

Acknowledgments.

I must express my appreciation of the arduous work carried out by Mr. E. Harrison and Mr. G. M. Hamilton in selecting out 11,000 rust resistant plants from a field of

" Cross XI " in the Trans Nzoia and ripening them off in trenches, and to Mr. Leach, of Chorlim Estate, Kitale, for doing the still more arduous work of sowing in separate plots the progeny of 3,000 of these plants.

I am indebted to Mr. Patten, of Gilgil, for the care of and interest he has taken in the experimental wheat plots he has allowed us to sow on his farm. Much of the work of harvesting has been done by him. My thanks are also due to Lord Egerton of Tatton, for allowing me to continue to use the land at Njoro hitherto lent me by Messrs. Sewall and Wright. I owe a very sincere debt of gratitude to Mr. E. H. Wright, of Njoro, for the unfailing courtesy he has shown me and ever willing assistance he has given me at Natai Emuin Farm, Njoro. It is no exaggeration to say that but for his interest and help the production of wheats resistant both to black stem rust and yellow rust would not be in the satisfactory position it is now. Last, but not least, I must acknowledge my satisfaction with the results of the incursion into the plant-breeding section, during my absence on leave from August, 1925, to June, 1926, of my colleague, Mr. E. Harrison, Deputy Director of Agriculture. The interest he has always taken in my work stood him and me in good stead. He realised that an important part of plant-breeding work was to throw away as many plants as could possibly be spared, and that the more plants that were thrown away the more concentrated the rest of the work became. The work was efficiently done, with the consequence that on my return from leave I found all my favourite cultures growing in the cage and all the ones that I was hesitating about irrecoverably thrown away. This has taken a great load off my mind. I must add that I found that all the cultures had been most accurately harvested, threshed and sown. The notes on rust taken by Mr. Noble during my absence have been of great value.

G. J. L. BURTON,
Plant-Breeder.

APPENDIX I.

Report of Senior Coffee Officer.

Travelling.

I travelled by motor car, on Government duty, 4,553 miles, and was absent from Head Office for 104 days on duty.

Field Demonstrations, Lectures and Meetings.

A number of pruning demonstrations were given on individual plantations. Tours, which were arranged by the Coffee Planters' Union, were made on the 1st and 2nd March, in the Kyambu district. A number of useful discussions took place, but the attendance was disappointing. On the 4th March members of the Union visited the Scott Agricultural Laboratories, where lectures were given by the staff and a general discussion took place on the result of the tours. I attended the Annual General Meeting of the Coffee Planters' Union on the 5th March.

A special meeting of the Kipkarren Association was held on the 15th November, which was attended by a representative of the Coffee Planters' Union Committee and by myself, to discuss the question of the introduction of " Robusta " coffee into certain parts of the Highlands. This matter was brought up during the year by certain settlers in the Uasin Gishu district, who approached the department and requested that they be allowed to import " Robusta " coffee plants for trial in their district, as " Arabica " was not giving satisfactory results on their farms. The matter was discussed at two committee meetings of the Coffee Planters' Union, and your suggestion that a meeting, to be organised by the Union, to be held in the Uasin Gishu, at which the local planters should meet representatives of the Coffee Planters' Union to discuss the subject, was carried out and the following resolutions were passed :—

(1) That the introduction of " Robusta " coffee into this district (Uasin Gishu) be not entertained;

(2) That the Honourable the Director of Agriculture be asked to start an experimental plot on some shamba in this district. The plot to be under the direction of the Senior Coffee Officer and no varieties to be introduced except with his authority.

Agricultural Conference.

From the 17th to 28th August I attended the Agricultural Conference, at which I read a paper on " Some Aspects of Coffee Production in Kenya," and gave a magic lantern lecture.

Interviews.

I held 304 interviews in my office with coffee planters and visitors to the Colony.

Correspondence.

Inward letters numbered 410. Outward letters numbered 407. 15 notices were served, under the Diseases of Plants Prevention Ordinance, to occupiers.

A classification of all the insect pests found on coffee plantations during the past ten years was made and submitted to the Entomologist.

Publications.

(1) Bulletin No. 1 of 1926: "The Coffee Industry of Kenya Colony."

(2) Paper read at the Agricultural Conference: "Some Aspects of Coffee Production in Kenya."

(3) Leaflet: "A Coffee Pulping Station"; illustrated with two plans.

Statistical Records.

From statistical information obtained as at the 31st July, 1926, there are 714 coffee planters in the Colony, representing 39 per cent. of the occupiers in the country.

The total area of coffee planted was 68,950 acres. This figure shows an increase of 3,810 acres, or 5.86 per cent. over the previous year. The area of coffee which can be regarded as being in the bearing stage in 1925 was 38,900 acres; in 1926 this figure is recorded as being 46,000, showing an increase of 7,100 acres over last year's return.

Yield.

The production has not increased in proportion to the increase of acreage coming into bearing, but this can be accounted for by a combination of factors, the chief cause being labour shortage. For example:

(*a*) Many thousands of acres of coffee are not being properly pruned and each year the unpruned and scantily pruned trees bear less and less;

(*b*) Hundreds of acres of coffee have been stumped and they are non-productive for two years;

(*c*) It is estimated that during the harvest many hundreds of tons of coffee were lost owing to the labour shortage;

(*d*) The season 1924 was a very dry year, and this affected the growth of new wood for the 1925-26 crop, also in 1925 there was a general deficiency.

The estimate of production of 1925-26, July-June, was 153,729 cwts., including 19,138 cwts. *buni*. The estimate of production for 1926-27 is 161,498 cwts .

Price in London.

The average price, in London, for " Kenya " Coffee for the season 1925-26 (July-June) was Sh. 111/9 per cwt.

Exports.

During the year ended 30th June, 1926, 143,404 cwts. of coffee were exported from the Colony, valued at £771,830. This figure represents 36 per cent. of the value of the total agricultural exports of the Colony.

Inspections.

During the latter part of the year more attention was given to visiting certain plantations in connection with experiments, than to inspection work under the Diseases of Plants Prevention Regulations. The total number of inspections made was 149.

The following is a summary of the diseases and pests noticed in the districts visited :

SUMMARY OF THE DISEASES AND PESTS NOTICED IN THE DISTRICTS VISITED.

District	Number of plantations visited.	Second and Subsequent visits.	Total number of visits.	Fungoid Diseases				Insect Pests.												Notices served under Diseases of Plants Prevention Regs.
				Leaf Disease	Brown Blight	Coffee Berry Disease	Root Disease	Waxy Scales	Asterolecanium.	Green Scale	Brown Scale	Mealy Bug	West India Red Scale.	Antestia.	Thrips.	Cutworms.	Borer.	Leaf-eating Caterpillars	Leaf Miner Moth.	
Trans Nzoia	45	2	47	26	3	6	–	–	–	20	1	1	–	–	9	5	–	–	28	4
Uasin Gishu	14	1	15	9	2	4	–	1	–	7	–	2	–	–	–	–	–	1	4	1
Songhor	26	–	26	24	16	–	–	–	–	6	–	1	2	6	11	3	2	–	–	2
Nakuru-Solai and Subukia ..	4	–	4	4	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–
Limuru	2	1	3	1	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	1
Ngong	1	1	2	–	–	–	–	–	–	–	–	–	–	1	–	–	1	1	1	–
Nairobi and Parklands ..	1	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Kyambu	13	12	25	7	–	–	–	–	–	3	–	3	–	–	–	–	–	1	5	4
Ruiru	3	–	3	3	–	–	–	–	1	–	–	2	–	1	–	–	–	–	3	–
Thika	18	3	21	20	7	–	1	5	9	16	5	9	–	5	10	–	1	–	12	1
Nyeri	2	–	2	2	–	–	–	–	–	1	–	–	–	2	–	–	–	–	2	–
Kaimosi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Totals	129	20	149	97	33	10	1	6	10	58	6	18	2	15	30	8	4	3	55	15

Leaf Disease.

This disease was very prevalent in the Trans Nzoia, Uasin Gishu, Songhor and Thika districts. Every season a considerable amount of defoliation occurs later in the year, which is the time the trees commence to feel the effect of nourishing the crop; in consequence of this considerable die-back occurs and the " tail end " of the crop has to be stripped and treated as *buni*. I have dealt with this subject fully in previous annual reports regarding the question of spraying and manuring. There would be less loss of crop and injury to the coffee bushes if coffee planters, in certain districts, sprayed at least those fields which were giving promise of a big crop. Some of the worst affected areas have been producing crops for years and no manurial treatment—which would undoubtedly render the trees more capable of withstanding the disease—has been carried out.

Brown Blight.

Reported on 33 plantations out of 129, of which 16 occurred in Songhor. This fungus, together with leaf disease, plays a very important part in the defoliation of the bushes, especially when the trees are bearing a heavy crop. The spray used for leaf disease controls this fungus.

Coffee Berry Disease.

A very serious outbreak was reported from Kericho. It was stated that the whole crop was attacked by this disease, and lost. In the Uasin Gishu and Trans Nzoia districts it was observed that the worst affected cases occurred on coffee in a neglected condition. This disease has now occurred in the following districts—Uasin Gishu, Trans Nzoia, Upper Songhor (Nandi) and Kericho.

Pink Disease.

Severe outbreaks were reported from Kaimosi. This is possibly due to the very heavy rainfall which occurred there throughout the year.

Asterolecanium.

This scale does not appear to increase very rapidly, but at the same time it is becoming a serious pest in the Thika district. Spraying seems to be practically useless, but in one or two cases fairly good results have been obtained with " Agrisol."

Green Scale.

Capex lime sulphur is being generally used and with good results when properly applied. If a nozzle which produces too fine a mist is used or the under surface of the leaves not sufficiently wetted, no good result will be obtained. It seems essential that the spraying should be carried out in the cool of the afternoon. In certain affected areas, where ladybirds have been found feeding on the scale, the green scale has disappeared without the use of an insecticide.

Coffee Plant (3 years old) "Blue Mountain" at Stott Agricultural Laboratory

Mealy Bug.

No serious outbreak was noticed. This might be accounted for by the fact that the "Creosoto" bands properly applied have been effective in stopping the activities of the ants, thus allowing the habitual parasites, of which there are many, to get the upper hand of the mealy bug.

West India Red Scale.

This scale has been reported once before by me, when it was found in the Sotik district. The coffee bushes which were affected in Songhor district were literally covered with this scale, but fortunately not more than about twelve trees were attacked. These were cut down and burnt.

Antestia.

With one or two exceptions, no serious outbreaks were noticed. The poison bait mixture has been recommended and has given good results.

Thrips.

No serious outbreak occurred on any of the plantations visited.

Cutworms.

The aluminium shields which I have had under trial for over a year are found very satisfactory, especially owing to the fact that they do not rot. So far as the cutworm affects coffee, I consider the problem is solved if coffee planters take the precaution of shielding the young coffee plants with this type of shield.

Experimental. Scott Agricultural Laboratories.

The following types of *C. arabica*, "Kent's," "Jackson's," "Blue Mountain," Mysore and Mocha, which were planted out into the field in 1925, are making good growth. At this early stage, so far as this experiment is concerned, it is felt that no safe comparison can be made of the various types under observation.

During the long rains of 1926 an area of an acre-and-a-half was planted up with Jackson's, Mysore, Blue Mountain and Mocha. No Kent's was available.

Nurseries are being established with specially selected seed of certain local types of bronze-tipped coffee.

The multiple system is being established on the "Agobiada" and "Capping" method, and there will also be an area established on the single stem system.

There is nothing special to report with regard to the shade trees under trial, except that the "Mukuyu" is making very slow growth.

Coffee Trials at the Coast.

The following two species of coffee, *C. Robusta* and *C. Liberica* and two varieties of *Robusta* will be distributed in March, 1927, to certain European settlers at the Coast for experimental purposes :—

C. Robusta
C. Bukobensis
C. Quilloa } *Robusta* Group.
C. Liberica

These plants were grown at Amani by kind permission of the Director of Agriculture, Tanganyika Territory, and sent to the Scott Agricultural Laboratories, for distribution.

Jackson's and Kent's.—These two varieties of *C. Arabica* were introduced into the Colony from India, and have been under trial in different parts of the country for some years. From observations made it is considered that neither of these varieties have proved to be any better, if as good, as *Mysore*, *Mocha* or *Blue Mountain.*

Mocha.—At 6,000 feet and under this variety has given very good results.

Mysore.—This variety is recommended for the higher altitudes, 6,000 feet and over.

Blue Mountain.—This variety has been recommended in the past for high altitudes. It was originally imported from the Blue Mountains, Jamaica. It is considered a very good yielder, but *Mysore* is now recommended in preference to *Blue Mountain*, as it appears to be a hardier variety and therefore more suitable for the higher altitudes.

Local Bronze-Tipped Coffee.—Good progress is being made with regard to establishing a hardy strain of coffee by special seed selection from certain types of local bronze-tipped coffee.

Stumping.—Large areas of coffee established on the single stem system are being stumped and converted into the multiple system.

Agobiada.—Very satisfactory results have been reported and seen of coffee established on this system.

Capping.—This system, although not so favoured as Agobiada, appears to be the most suitable at low altitudes, where growth is rapid. It has, however to be proved whether coffee established on the multiple svstem, in districts where there is a small rainfall, will be a success.

Shade.—Shade experiments are still under observation. The enthusiasm first displayed by coffee planters in the matter of shade has, however, died down. It is not proposed to

deal with these subjects, viz. : Stumping, Agobiada, Capping and Shade, in this report, as the subjects will be fully dealt with in a bulletin which will be published shortly.

Artificial Shade.—Coffee under this form of shade continues to give good results. There are, however, two apparent disadvantages :—

(1) The cost of erection;

(2) The upkeep, replacing the canopy from time to time. and carrying out general repairs.

GENERAL.

Labour.—Labour shortage has affected the coffee industry in many vital ways. With a few exceptions coffee planters have experienced much difficulty in carrying out systematic pruning and manuring, which in both cases tend to decrease the output. Although there are many coffee planters who have suffered loss through no fault of their own, there are cases where wastage of labour occurs. Economising labour, which amounts to good estate management, will certainly not solve the present shortage, but would go a long way to alleviating same.

Coffee Exhibits at the Agricultural Shows.—I assisted in judging the coffee exhibits at the agricultural shows held at Nakuru in January and December. It is regrettable that there is such little interest taken by the coffee planters in exhibiting the country's chief agricultural product.

Coffee Thefts.—Several cases of coffee thefts have been brought to my notice. It is to be expected that coffee thefts throughout the country will increase as the native becomes more civilised, and as in other coffee growing countries, the coffee on the estates will have to be kept under lock and key. Investigating coffee thefts might be made much easier if all coffee planters observed Rule 7 under the Registration of Coffee Plantations Ordinance, and it is also questionable whether all coffee dealers keep a register of their purchases and sales as required by law.

Movement of Coffee Plants Regulations, 1925.—Two cases occurred where coffee plants were received from a prohibited area, in each case the recipient was ordered to uproot and burn the coffee plants.

The coffee position as indicated by statistical information is most satisfactory from the growers' point of view. The world average production of the last six years was approximately 19,600,000 bags. The world average consumption during the same period amounted to approximately 20,500,000 bags. This figure shows that the average of production is less than the average of consumption. The

decrease in stock year after year would indicate this. It is estimated that the world average consumption to-day is 22,000,000 bags and the world production for 1926-27 will not amount to 20,000,000 bags. Every attempt should be made to increase production in Kenya as the consumption of the article is increasing.

ARTHUR D. LE POER TRENCH,
Senior Coffee Officer.

APPENDIX J.

Report of the Chief Grader and Inspector.

Staff Changes.—Mr. F. B. L. Butler proceeded on leave on 17th May, and had not returned by the end of the year.

Mr. B. F. Ratcliffe returned from leave to the appointment of Assistant Grader and Inspector, on 21st June.

Mr. Riddell, clerk, was transferred to Nairobi on 6th March, 1926.

Mr. Myers, clerk, was transferred to this office from Nairobi on 26th February, 1926, and proceeded on leave on 30th October, 1926, being relieved by Mr. S. G. Sharp.

On November 17th, owing to the absence from duty of Mr. Butler and Mr. Ratcliffe, Mr. H. J. Taylor, Agricultural Supervisor, assisted the grading until the end of the year.

Plant Import Inspection.—The following plants, seeds and apples, were passed for importation into the Colony and Protectorate during the year :—

Description.	No. of packages.	Declared value.
		Shs. cts.
Seeds	789	35,134 47
Plants	214	2,339 95
Fruit Trees	306	34,518 25
Bulbs..	116	3,107 02
Tree seed	32	1,320 50
Tea seed	831	85,062 00
Apples	1,153	17,080 16
	3,441	178,562 35

In addition 138 packages were passed in transit to Uganda.

MAIZE GRADING AND CONDITIONING SERVICES.

Maize Grading.—I attach a table showing the number of bags graded each month with their grades. The total is 77,000 bags less than in 1925, and 147,000 less than in 1924. Of the total of 542,852 bags it is estimated that 120,000 or 24 per cent. were native grown.

In addition to this, 68,000 bags were shipped without a certificate to African ports, as provided for by No. 25 of the Maize Grading Rules. Very little of this had been graded, and it mostly consisted of rejected and ungraded maize.

49,336 bags were rejected as wet during the course of grading. The following table shows the district where grown, and the average moisture contents of the rejected maize :—

District.	No. of Bags.	Average Moisture Content.
Kisumu	5,574	14.6%
Nakuru	9,815	15.5%
Kitale	6,576	14.0%
Soy	1,359	15.2%
Turbo	2,889	14.1%
Eldoret	845	13.8%
Hoey's Bridge	7,763	13.9%
Turi	110	13.0%
Lumbwa	171	13.6%
Fort Hall, Thika, Maragua, Sagana	13,301	14.9%
Moshi	148	14.1%
Fort Ternan	402	14.6%
Wet by rain	383	
	49,336	

In addition to the above about 30,000 bags were sent to the conditioning plant to be dried before grading.

The dry season of 1925-1926 accounts for the comparatively small quantities of maize graded during the early part of the year. The favourable weather of 1926 however, shows a prospect of a far bigger crop during the coming season.

Shipments in Bulk.—For the first time since the Grading Ordinance came into force, maize was shipped in bulk. Maize was graded in bags, and put on board in the ordinary way. The bags were then emptied into the hold and returned on shore. Altogether shipment of 69,000 bags were made in this manner. In view of the difficulty of disposing of a large quantity of second-hand bags, the grading rules were altered to enable shippers to rail maize to the coast in second-hand bags, for shipment in bulk, provided that the inspector may refuse to grade maize so railed, if satisfactory arrangements have not been made to re-bag, within twenty-four hours of grading, any maize that is found to be of a grade not required for bulk shipment.

During August an experimental shipment was made. Of the 3,656 bags received, only 2,472 bags were graded No. 2, the grade required for shipment in bulk. The remaining 1,184 bags, 32 per cent. of the whole, were either weevily,

slightly weevily, wet, musty, or undergrade It is improbable that so large a proportion of rejected maize will be unusual, the lateness of the shipment accounting to a great extent for the high proportion of rejections.

The weighing of ten per cent. of the bags on arrival here was continued by the Kenya and Uganda Railway. 111 trucks, containing 25,710 bags, were rejected as underweight.

Re-bagging and Re-sewing.—3,902 bags were re-bagged and 4,692 bags re-sewn by the Kenya and Uganda Railway. In addition, 2,000 bags were re-bagged and 4,000 re-sewn, by the owners following rejection by the grader prior to grading.

Re-grading.—Owing to deterioration whilst in block stack after grading, it was found necessary to re-grade 2,870 bags, and consequently to reduce to a lower grade 283 bags.

Maize Conditioning Plant.—81,234 bags of wet maize, and 24,742 bags of weevily maize, a total of 105,976 bags, were conditioned during the year. Of this total 70,000 were conditioned during the period September to December. During the last week of September the native maize began to come forward, and it was clear from its condition that, in the majority of cases, no attempt of any sort had been made to dry it before putting it on rail. As a result, partly from this and partly of delays in receiving requests for treatment, the capacity of the conditioning plant was overtaxed, and maize awaiting conditioning accumulated, until, by the 14th October, there were 8,000 bags on hand, a figure which rose to 16,600 by the 2nd November. This period of congestion continued until the 9th December, by which time the amount on hand was reduced to 700 bags.

To cope with the quantity of wet maize the working hours of the plant were increased, until by the 20th October the plant was running continuously day and night for 120 hours per week. The cessation of the export of native maize occurred more suddenly than usual, and very little came forward after 1st December. The arrears of maize awaiting conditioning were cleared off by the second week, just as the European crop began to be moved, and although the working hours were reduced to sixteen per day for a short period, it was soon found necessary to resume the twenty-four hours' working day, and to continue at that rate until the end of the year.

On and after 1st October, the charge for conditioning maize consigned direct to the plant, was reduced from sixty cents to fifty cents per bag, on the understanding that maize rejected in the wharf sheds should receive priority of treatment. Owing to the congestion during October and November, no maize could be received on these terms, but during December 1,252 bags were treated at the reduced rate.

It is satisfactory to record that the machinery as installed by the manufacturers has worked throughout without showing any serious mechanical defects, the only involuntary stoppages being due to the stretching of the elevator belts—inevitable in a new installation—and the occasional failure of the electric current.

Export of Beans.—Certificates were issued for 4,472 bags of beans, producing a revenue of Shs. 223 cts. 60.

Export of Potatoes.—95 certificates of freedom from wart disease, covering 14,103 bags and 1,602 barrels of potatoes, were issued during the year, free of charge, for potatoes exported to India and South Africa.

Export of Flax.—The Grading of Flax Rules were repealed by notification in the Official Gazette dated 3rd March, and the inspection of grade marks at the port ceased from that date.

C. C. SHARP,
Chief Grader and Inspector.

APPENDIX K.

Report of the Agricultural Supervisor, Scott Agricultural Laboratories and South Kikuyu.

A. Staff Changes.

Mr. Spranger was in charge here from 1st January until 1st May when he was transferred to Bukura.

Mr. Taylor was appointed an Agricultural Supervisor and relieved Mr. Spranger on 1st May. He was here till early in September, when he was transferred to Mombasa.

Mr. W. G. Leckie was appointed an Agricultural Supervisor and assisted here from 13th to 31st May, when he was transferred to Embu.

The writer resumed duty on 16th July, from home leave.

B. Travelling.

3,239 miles by motor car.

Throughout the year 81 days were spent in the Reserve and out of this station on duty by the above-mentioned officers.

C. Correspondence.

Inward letters : 137 ; outward letters : 242.

Sixteen letters were advisory (not including enquiries from Government departments nor on native agriculture).

D. Reserve.

1. *Barazas and demonstrations.*—69, exclusive of Native agricultural instructors.

2. The Mission schools in the district have been co-operated with when necessary.

3. *Demonstration gardens of Native agricultural instructors.* At the end of the year we had 14 plots. These have been mostly worked by the instructors themselves, but in some cases the natives of the district assisted with the digging. In the past there has been continual damage wrought in these plots by the cattle and goats, and to obviate this in future we have planted hedges around the shambas. During the short rains a number of the shambas were planted with cover crops, which will improve the soil while the hedges grow up.

There has been a difficulty experienced with some of the instructors in regard to the cultivation of their plots. There is the usual native belief amongst them that now that they have endured a period of agricultural training they ought to be suited to cleaner and easier employment than digging land. They also strongly resent having to perform honest digging operations in view of the women in the Reserve.

Throughout the year there has been an increase in the number of male voluntary seekers of agricultural enlightenment. This section is restricted almost entirely to the educated natives who are resident in the Reserve. More native men are working their shambas themselves and again the increase appears to be greater amongst the educated boys who are better able to appreciate the fact that more than food can be derived from such labours.

Where the instructors have been working for some time in the past there is very distinct evidence of new agricultural methods being adopted by the local native shamba workers.

We have found that the native instructors can convey certain teaching with advantage at the native markets, when they are conveniently situated to them.

4. *Reserve Conditions.*—The administrative officers have continued to improve the roads and the natives are taking advantage of them. Four native-owned ox waggons were observed at a native market on a new road in the Mukinyi district in November, and a like increase has been seen elsewhere. It is difficult to estimate what the result may be and its influence on native agriculture in a few years time. The more energetic Kikuyu natives in the Reserve are resourceful and quick to appreciate any advantages which may crop up from time to time.

Mission School Gardens.—Some of the Missions are now teaching the children agriculture in their schools and several have a large number of small gardens for their pupils.

5. *Stock.*—There has been little of interest in this direction. The rains were good and gave a liberal supply of food, and the condition of the stock has been a great improvement on 1925. This has been most marked in the Uplands district, where the greater proportion of the cattle are grade. Compared with the native cattle, it has been seen in the past that the grade cattle suffer much more from adverse conditions.

6. *Grazing.*—This has been much better than during the last few years. The native instructors are making experimental plots where the landlords can be persuaded to release a few square yards. No exact weighing measurements have been made, but the turned-over and manured turf appeared to produce the biggest and most palatable flush of growth.

Example :—

Dug over. Cleaned and clover planted.	Dug over and beaten down.	Control	Dug over manured and beaten down.	Dug over and new grass roots introduced.

The village manure consists of cattle, goat, and sheep dung, wood ashes, sweepings of the village, etc.

The principal grasses in the South Kikuyu Reserve are :— *Themeda triandra*, *Setaria aurea*, *Andropogon pertusus*, *Pennisetum clandestinum* (Kikuyu Grass), and *Cynodon dactylon* (Doob grass, Bermuda grass, Uganda grass or Egoka (Kikuyu name)).

7. *Ghee.*—Practically nil. The administration have been working on a scheme to introduce water into the Ndeiya country, and when it is completed it may be possible to organise an efficient dairy.

8. *Poultry.*—Disease hinders the multiplication of poultry. Many runs were completely wiped out and in the location of Chief Karanja, beside Uplands, fully half the birds died during the latter half of the year.

9. *Trees.*—Nearly all the plantations in the Reserve are owned by the landlords. Many of these proprietors are beginning to realise that the trees are helpful to the district and are most remunerative. There is a sufficient quantity now for all present needs in the areas under 6,500 feet. Planting must continue.

Greater energy in planting is much required in the high and cold regions. Towards the end of the year our original efforts have been proved to the Uplands natives. Protection from the cold winds has helped the crops greatly, and now we have to continue to encourage the landlords to systematically plant up shelter and firewood belts.

10. *Maize.*—The crop during the big rains was perhaps considerably above average, though far below a reasonable amount to be produced by the resident population. The season was a longer one than usual and many of the natives had to plant their short rains maize between the standing crops of the previous season, and without any attempt at cultivation. This crop appeared to be in a precarious condition for a while in December, but at the time of writing some rain has fallen and a small crop will be harvested.

In the higher reaches of the district the maize was much above average, especially in the more enlightened part at Uplands. It is unfortunate that they had a visitation of frost

during the last days of the year, which will cause a considerable reduction of crop, except in the shambas with a western aspect or those with shelter belts of trees on their eastern side.

The natives in some parts of the Reserve again planted low yielding maize.

11. *Wheat.*—There is a growing increase in the amount planted.

12. *Beans.*—The improvement in pure sample lots is slow.

13.—*Field Peas.*—This crop is gaining popularity in the areas suited to it, and was found at lower altitudes than was customary in previous years.

In the Uplands location this crop far exceeded that of any previous year and the price being about Shs. 6/00 per load the natives have found it most remunerative.

14. *English Potatoes.*—The most suitable districts for this crop are around Uplands and Limuru, where it is on the increase. The Limuru crop was a good one but around Uplands the natives planted rather late and missed the best of the big rains.

Many of the natives have a great tendency to encourage and protect non-productive volunteer plants, while many are now adopting the rotation system and planting good seed. Two crops are produced each year and natives in the vicinity of the railway have found potato growing a profitable undertaking.

15. *Seed Issues in the South Kikuyu Reserve* :—

	lbs.
Maize, Flat White	200
Maize, Flat White (Special Selected) ...	30
Maize, White Pearl	218
Wheat	1,190
Beans, Canadian Wonder	247
Buckwheat	197
English Potatoes	640
Bulrush Millet	7

16. *Insect Pests.*—In the Chania region of the South Kikuyu Reserve the mealy bug increased its activities very considerably and effected considerable loss, of yams and pigeon pea especially. When the plantations were again examined towards the end of the year, the pest appeared to be very much on the decrease and ladybirds were seen in large numbers. The dirty and lazy methods of cultivation which are practised by the natives have greatly assisted the spread of this pest.

17. *General.*—While the natives continue to mix crops, and to be restricted in their selection of gardens by the "Githaka" owners, they will always lose a large proportion of their grain, especially with crops such as millets, which can be destroyed so easily by birds. If these crops could be systematically planted in a position near to the homes of their owners, a very great saving could be effected in labour and produce.

Too high a proportion of the time is being spent by the individual natives in misdirected energy, such as court cases, drinking, walking long distances to their gardens, and in bargaining. A native will produce a load of potatoes with the minimum of exertion, but he will willingly spend several days in obtaining the highest possible price for it.

The price of native produce is far too high in and around the Reserve. This is due in a large measure to inefficient labour and lack of energy amongst the agricultural workers. The land must be made more productive and this will only be attained by more, and intelligent work.

Selection of seed at harvest time for the coming planting season must be learned by the natives. It is their habit to put all seed in the store and to tap it daily for their food requirements. When seed is required they use what is conveniently at hand. We have spent some time in recommending better methods and hope yet to produce improvement in the seed year by year, instead of the continual deterioration which has happened in the past.

Land.—Some of the educated natives who have saved some wealth are purchasing land from the present landlords.

Ploughs.—A few small ploughs are being used, but the increase in popularity is slow.

E. SCOTT AGRICULTURAL LABORATORIES.

Instructional.—At the end of the year there were 34 apprentices. During the year 28 boys completed their training and are now situated as understated :—

9 Agricultural instructors;

5 Just finished training and awaiting vacancies;

3 Mission teachers;

4 Trading;

7 Other occupations.

The course of the apprentices is a very practical one and all branches of agricultural field work have to be undertaken by them. This includes such duties as ploughing, cultivating and carting with oxen, repair of implements and machinery, methods of sowing and planting, harvesting, threshing and cleaning seeds, selecting seeds and roots, nursery and store-keeping work, poultry keeping, etc.

School learning was worked in conjunction with the field work and each class had daily two hours study in the following subjects: reading and writing, English and Swahili, arithmetic, geography, history, and hygiene.

All pupils had agricultural lectures, and most of those who finished the course had received instruction in all subjects in the agricultural curriculum.

The school was divided into the following classes to convenience teaching: Senior, First, Second, and Junior boys. Each class attended 496 hours during the year.

Agricultural lectures.—The school is divided into first and second lecture classes and received lectures as follows:—

1st Class	...	...	...	75 hours
2nd Class	...	...	...	63 hours

When natives join the school there is always a great variation in their standard of previous schooling and as a general rule the uneducated are unable to follow the lectures for some twelve months or thereabout.

School gardens.—Each pupil has to work a plot of one-twentieth of an acre during his own time, and has to plan and plot his garden according to his own ideas and skill. The quality of these gardens in 1926 was above average and reflected great credit on the workers. The gardens generally indicate pretty accurately the ability and temperament of the owners.

Experimental.—Kenya Flat White Maize, Special Selected.—A special selection of cobs was made by the Hon. Director of Agriculture from selected maize received from Mr. Simpson, of Nakuru, and perfect seeds were planted for breeding purposes here in 1925. At the same time, maize variety trials were conducted with this and other types of maize on land of even condition. This trial proved that a heavy yielder was being worked upon. Cobs were selected from the resultant crop and a three-quarter-acre breeding plot was planted in 1926. During growth the imperfect stems were eliminated at an early stage and the behaviour of the crop was carefully observed. Though the yielding capacity could not be measured, due to the incomplete stand, the crop had a very fine appearance and nearly all the cobs were above average quality.

Special selections have again been made for the "breeding plot" of 1927.

White Pearl Maize.—On another section of the experimental land this American maize was again planted but proved a very inferior crop. Germination in the first place was poor and in later growth the leaves suffered from a dieback. Seed from selected cobs was again sown during the short rains and

a perfect stand has resulted, but as in the previous season the leaves have again commenced to wither. This maize was planted by the apprentices in their gardens and no leaf dieback has been seen. The Mycologist is investigating the matter.

Green Manure.—A selection of seed of leguminous plants suitable for green manure and cover crops was made, and 55 plots were sown in March. Observations were periodically made during their growth. The Agricultural Chemist has undertaken their measurement. A new series of 21 varieties was sown in November.

Manurial Plots.—These 144 individual plots were again treated and planted with wheat. The work was performed under the direction of the Agricultural Chemist and all measurements were made by him.

Grass Plots.—36 one-fortieth-acre plots were on the land. 3 are exotics and the remaining 33 are indigenous to Kenya. The greater number were collected by myself, and still a few have to be identified for the Mycologist by Kew Gardens.

A number of less likely varieties of forage grasses are being observed in small plots and the remainder of the 77 indigenous grasses which were collected have been destroyed as not likely to become of economic value.

Kikuyu Grass (*Pennisteum clandestinum*).—Nine experimental plots were laid down in 1925 with this grass in mixture with other grasses and clovers. The Kikuyu grass was propagated by means of *Rhizomes*, and as the first season was dry the other varieties became droughted or suppressed.

The Kikuyu grass was allowed to develop naturally and not grazed or cut and has produced 25,800 lbs, or approximately 11½ tons of rough green forage per acre. By the end of the twentieth month, when it was cut, the tops had developed a tussocky appearance and produced seed.

Fibre Plants.—The collection of indigenous fibre plants has been identified by Kew Gardens and recorded in the herbarium by the Mycologist. The field collection has been destroyed.

New Zealand Flax (*Phormium tenax*).—A collection of five varieties as understated was got from Kew Gardens and germinated well : (1) Hult's Gate, (2) Rock Rose, (3) Government Flax Land, (4) St. Helena Corporation, (5) Bamboo Hedge.

Coffee Variety Plots.—The original five half-acre plots which were planted in April, 1925, are healthy and evidence signs of a good crop in 1927.

Variety plots, under the Agobiada system, were planted in March, 1926, and are in a very healthy condition.

Five new varieties have been planted in the seed beds for the Senior Coffee Officer.

Wild Silk Plantation.—The insects were introduced by means of the pupæ-nests and have made progress. The leafage was still rather insufficient and only small nests were formed. During the feeding season the caterpillars were attacked by sucking bugs and had to be picked over a few times before the pest ceased to be a danger.

Yerba Mate (*Ilex Paraguayensis*).—Two small observation plots have been planted. The best bushes are now about two feet high and though healthy, are growing very slowly. Our conditions may be too cold and dry for best results. 15 lots of young plants have been issued to a number of districts where climatic conditions vary.

Hops.—25 sets were received from South Africa in 1924 and all have now died out. They produced a lively appearance when first planted out and then commenced to decline and die off.

Other Crops.

Rice.—Irrigation plots were made and seven varieties sown. All proved a failure.

Multiplication plots were sown of Buckwheat, White Pearl maize, White Cango maize, Bombay linseed, Alderman peas, 18 varieties of beans, 8 varieties of other pulses, 23 varieties of clover (3 indigenous), British Queen potatoes, bulrush millet, foxtail millet, broom corn, Kaffir corn, Adlay, sugar beet, mangel-wurzel, and 3 varieties of lupins.

Seed Beds.—84 sowings were made of a variety of plants during the year.

Cassava.

Kind	Planted				Time on Ground.	Yield per acre. (Undried)
	Date	Method	Distance	Area		
White	26–5–24	Cuttings	5′ x 5′	1/10 acre	24 months	10,110 lbs. or approx. 4½ tons.
Red ..	6–11–24	Cuttings	5′ x 5′	1/5 acre	18 months	20,680 lbs. or approx. 9¾ tons.

Castor.—A half-acre plot was planted in 1925 of a local variety which had been previously tried in the castor variety plots. During growth the plants became infested with a Pentatomid bug, sp. *Nzara.* The flowering spikes were attacked chiefly, and no seed set.

Crop of Kenya "Flat White" as described.

Wheat.—A large proportion of the land was planted with Kenya Governor wheat and after threshing, 183 bags were handed over to the Plant Breeder for issue to farms.

Short Rains Crops, 1925-1926.—A severe drought was experienced and all catch-crops were practically a failure.

Short Rains Crops, 1926-1927.—Satisfactory. Selected crops harvested before the end of the year yielded as follows :—

Name	Planted				Time on Ground	Yield per acre
	Date	Rows	Seed	Area		
Beans Canadian Wonder ..	24-9-26	2′ apart	9″ apart	1/120 acre	103 days	2,151 lbs.
Beans, Rose Coco ..	,,	,, ,,	,, ,,	,, ,,	122 ,,	1,716 lbs.
Beans, Haricot. ..	,,	,, ,,	,, ,,	,, ,,	,, ,,	1,365 ,,
Cow Bean, Variety	,,	18″ ,,	8″ ,,	,, ,,	,, ,,	1,249 ,,
Peas, Field var. ..	,,	2′ ,,	,, ,,	,, ,,	,, ,,	1,413 ,,

Experimental Land. Weeds.—Mexican Marigold, Khaki, or Stink Weed (*Tangestes minuta*). Towards the end of the year a few plants were found in the land and destroyed. This weed was first observed by the writer around Nairobi South and out towards the Ngong-Dagoretti cross roads in 1925, and a few plants were seen and destroyed outside the Scott Agricultural Laboratories about the same time. It appears to be spreading and may become a noxious weed amongst crops and grazing land. It was most likely introduced into Kenya during the War in South African forage.

Little difficulty has been experienced in keeping the land free of weeds.

Poultry.—At the end of the year there were :—

5 males, Rhode Island Reds;

8 hens, Rhode Island Reds;

15 chickens, Rhode Island Reds;

9 shenzi hens.

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Agricultural Supervisor.

The influence of a bean crop, when the land had previously borne a variety of crops was very marked and measurements were taken of the final yields, as under:—

Number	Big rains, 1925	Short rains, 1925.	Big rains, 1926	Short rains, 1926.	Beans planted	Period on ground.	Yield of beans per acre.
1	Maize	English Potatoes.. ..	Maize	Canadian Wonder Beans	18″ x 9″	98 days	1,480 lbs.
2	do.	English Potatoes.. ..	do.	do.	2′ x 9″	do.	1,340 ,,
3	do.	Barley	do.	do.	do.	do.	960 ,,
4	do.	Wheat	do.	do.	do.	do.	810 ,,
5	do.	Oats	do.	do.	do.	do.	1,540 ,,
6	do.	Rye	do.	do.	do.	do.	1,560 ,,

APPENDIX L.

Report of the Senior Agricultural Supervisor, Nyanza.

Staff.

Mr. Booth left Bukura on 8th May, being relieved by Mr. Spranger.

Undersigned left Kisumu on 4th April on leave, and on return took over from Mr. Spranger on 7th December, when the latter proceeded on leave.

Mr. Hartley has been stationed here for the whole year.

For the best part of the year the staff in the province has consisted of two officers stationed at Bukura.

Rainfall.

An abnormal season has been experienced, and the rains have been much above average, there being little break between the big and small rains. Crops have suffered as a consequence, and yields have been on the small side.

NORTH KAVIRONDO.

Cotton.—Buying commenced on 4th January, though the crop generally was backward. Prices ranged about 16 cents to 17 cents for first grade cotton.

Folkes and Hilton, the B.C.G.A., and Gordon Small all had buying posts in the district, though in one case the actual buying was found to be unsatisfactory.

The posts were established as follows :—

Folkes & Hilton—Nambare, Busia, Adangusi, Lukoli, Eunysata, Marach, and Mataya.

B.C.G.A.—Malakisi, Lakwaka, Tororo Road and Lokoli.

Small & Co.—Busia and Lokoli.

Considering the adverse growing conditions a good crop was picked. Total purchases were :—

First grade seed cotton ...	1,377,835 lbs.
Second grade seed cotton...	50,275 lbs.
Total ...	1,428,110 lbs.

The number of bales exported were :—

Folkes & Hilton	361
B.C.G.A.	372
Small & Co.	321
Total ...	1,054

1926 Crop.—Except for the area round Locolis, a much smaller acreage has been planted this season. Yields promise to be on the low side, a fact largely due to lack of proper cultivation, most of the natives being content to scratch the soil over, rather than dig it.

Buying will commence on 10th January, but little cotton will be ready then, the wet season having held back the plants.

Maize.—An issue of 80 bags of white flat maize was made to the Kabras area in May. Owing to late planting a very small crop was reaped. The maize generally in the district has been rather poor, the heavy rains experienced being responsible for considerable damage, and the Maragoli area in particular suffered.

Rice.—The ton of paddy seed issued to Wanga and South Kitosh locations proved a success, and good harvests were reaped. Natives here are now busy preparing shambas for fresh plantings in January.

Simsim.—A good crop was obtained early in the year, Mumias and Butere being the chief buying centres. At the present moment a fair crop only is promised. Picking is now starting.

Food Crops.—In the northern area harvests were very moderate, and the small rain crops have not been good. There should however be little shortage of food.

In the southern area conditions have been much worse, especially round Maragoli and Teriki. Very poor main crops were reaped, and owing to sickness a small area only was planted up in the short rains. These crops do not promise well, and a serious shortage of food will soon be felt here.

Native Show.—This, the first of its kind, was held near Mumias on 18th February. The produce section was a great success, both as regards the quality and number of the exhibits, which totalled 646.

Demonstration plots.—These were established at the following centres—Broderick Falls, Kimilili, Malakisi, Lukolis and Amians.

Each plot is in charge of a native instructor, and crops suitable to the different localities have been grown.

Central Kavirondo.

Cotton.—In the Kisumu and Asembo areas the cotton was picked by the end of the previous year. In the Sio area, however, picking started in December, 1925, and a fair crop

was obtained. Prices varied from 17 cents to 15 cents per lb. for " A " grade cotton, though dissatisfaction at these prices was shown by the growers. A certain amount of cotton came from across the border.

Ginneries and buying posts were as follows :—

Hasham Jamal & Co.—Kibos and Kisumu.

B.C.G.A.—Asembo and Kadimo.

Small & Co.—Sio, Luambwa and Mgandas.

Ginned cotton purchased was as follows :—316,874 lbs. 812 bales were exported.

1926 Crop.—Practically no cotton was planted this year in the Kisumu and Asembo areas, low prices and the general indifference shown by the native here for the crop being the main reasons, though ten tons of seed were despatched to Asembo, and five tons to Kisumu for issue. Twenty tons of selected Uganda seed were issued in the Sio area. The crop here is not nearly so large as in the previous season, whilst cultivation is still very open to improvement. Buying will commence on 10th January.

Maize.—A fair harvest only was reaped and markets were low, buyers being afraid of the maize being condemned at the Coast for dampness. Maize is, however, increasing in value as a food crop, and 227 Colonist Mills and 23 sets of millstones were sold in Kisumu during the year.

Simsim and Chiroko.—A good crop was reaped early in the year, but prices were low, Shs. 4/50 per frasila being obtained for the former, and Shs. 3/00 to 3/50 for the latter. At the present moment a fair harvest is promised, and the acreage under simsim appears to be on the increase.

Food Crops.—Moderate harvests were generally obtained, and though the heavy rains did damage in parts, there should be no shortage of food, except in Sakwa and Kadimo, where food supplies are nearly always short.

Ploughs.—87 ploughs were sold to the more intelligent chiefs and natives in the course of the year, a sign that these labour saving implements are now beginning to be appreciated. A large number of these ploughs went to the Kano plains.

Demonstration Plots.—Plots under a native instructor were established at the following centres :—Sio, Uyoma, Luanda, Johanas, and Ogadas.

Native Show.—This was held at Messeno on 16th February. Whilst the number of entries was low, the quality of the exhibits showed a marked improvement over those of last year.

The following figures show the amounts of maize and simsim grown in Nyanza Province which have passed through Kisumu during the year :—

	1926	1925
Maize ...	7,084 tons ...	11,265 tons
Simsim ...	2,254 tons ...	2,076 tons

The above are the totals which passed through the station and pier.

Bakura Experimental and Training Farm.

Staff.—Native Instructors : 3; Labourers : 30.

A carpenter and bricklayers were employed in January and February but were then discharged owing to curtailment of funds.

Rainfall.—The rainfall for the year was 65 inches, 12 inches more than for the previous year. The excessive rains interfered with the harvesting of the crops, and made the task of keeping the fields clean a difficult one.

Buildings.—No new buildings have been erected during the year, though one instructor's hut was commenced.

Nursery.—Heavy rains again caused a lot of washaway. A number of beds of swamp rice were planted here, but whilst growth was good, the plants failed to set seed. Tree seedlings were again raised and planted out.

Stock.—Oxen on hand at 1/1/26 : 35; oxen on hand at 31/12/26 : 26. Nine oxen have died from old age. These were all condemned by the Veterinary Officer.

School.—At the beginning of the year 26 new pupils were enrolled, making a total of 57. As the result of examinations, however, the numbers at the end of March were—Senior class : 16; Junior class, 34. In July 11 more apprentices were discharged, and 12 more were signed on in September, the numbers at the end of the year being : Senior class, 23; Junior class, 82.

The school routine was organised so as to give alternate days to theoretical and practical work.

Each apprentice has a school garden one-twentieth of an acre in extent. On the whole the pupils' behaviour has been good, though some are inclined to become intractable during practical work, which they are still apt to look upon as degrading.

Time-Table. Class A. Senior.

	Monday	Wednesday	Friday
8– 9 ..	Arithmetic	Arithmetic	Arithmetic
9–11 ..	Botany	Botany	Botany
11–12 ..	English	Writing	Swahili
1– 2 ..	Geography	Hygiene	English
2– 4 ..	Agriculture	Agriculture	Agriculture

Class B. Junior.

	Tuesdays	Thursdays
8-9.30	Arithmetic	Arithmetic
9.30–11	Botany	Botany
11–12	Writing	Geography
1–2.30	Swahili	English
2.30–4	Agriculture	Agriculture

Each class has physical drill on school days from 6.30 to 7.15.

13 apprentices will have completed their three years course in June, 1927, and 7 more are due to finish at the end of the year. These pupils have made considerable progress and should undoubtedly prove useful instructors, etc., in the field.

FIELD CROPS.

Crop.	Variety	Area	Planted	Harvested	Total Yield.	Yield per acre.
		acres			bags	bags
Maize ..	Potchefstroom Pearl	2	15–3–26	18–10–26	8½	4¾
Maize ..	White Flat	21	14–4–26	24–10–26	231	11
Potatoes	Sweet	2	10–4–26	—	—	—
Maize ..	White Flat ..	8	21–4–26	24–10–26	120	15
Potatoes	Sweet	2	21–4–26	—	—	—
Sunflower	Russian Mammoth Striped	6	19–5–26	4–10–26	54	9
Wheat ..	Kenya Governor	1	4–6–26	Failure	—	—
Maize ..	White Flat ..	13	20–5–26	10–11–26	26	2
NATIVE DEMONSTRATION SHAMBA.						
Potatoes	Sweet	¾	20–5–26	—	—	—
Maize ..	White Flat ..	¾	,,	15–12–26	3	12
Simsim ..		¾	,,	Failure	—	—
					lbs.	lbs.
Chiroko..		¾	,,	20–12–26	30	120
Beans ..	C. Wonder ..	¾	,,	20– 5–26	Failure	—
Wheat ..	Kenya Governor	¾	,,	15–12–26	150	60
Buckwheat		¾	,,	30– 7–26	400	1,600
Beans ..	Broad	¾	,,	Not yet harvested		

DEMONSTRATION PLOTS.

Plot No.	Crop	Variety	Area	Date of Planting	Date of Harvest'g	Total Yield	Yield per acre.
1	Buckwheat		1 acre	9–6–26	18–8–26	1,549 lbs.	1,549 lbs.
2	Wheat	Kenya Governor ..	1 ,,	10–6–26	4–10–26	600 ,,	600 ,,
3	Linseed	.. ..	1 ,,	12–6–26	20–11–26	122 ,,	122 ,,
4	Buckwheat	.. ..	1 ,,	10–6–26	19- 8–26	1,452 ,,	1,452 ,,
5	Groundnuts	Sherati	1 ,,	3–6–26	31–12–26	502 ,,	502 ,,
6	Beans	Canadian Wonder ..	1 ,,	3–6–26	Failure	Nil	Nil.
7	Beans	do. ..	1 ,,	15–9–26	2–12–26	110 ,,	110 ,,
7	Chiroko	.. ..	1 ,,	12–8–26	28–12–26	200 ,,	200 ,,
8	Chiroko	.. ..	1 ,,	3–6–26	Failure	Nil.	Nil.
9	Gram	.. ..	.45 ,,	4–9–26	21–1–27	180 ,,	400 ,,
10	Simsim	.. ..	.45 ,,	4–9–27	21–1–27	50 ,,	111 ,,
11	Small Trial and Multiplication plots: Clovers	Chinese and Sweet, Bright red bean, Aldermann Pea Cape Province Lucerne, Hubam Clover, Soya Beans, Victor Cowpea Bambara Groundnut, Potatoes.					
12	Rice	Lowland 11 varieties* Masimang, Finu, Kisuki, Calibo, Manabun Ac., Dinalaga, Gruz, Apostle Macan No. 19, Conner, Mwanza seed. ..		17–5–26	10- 1–26	—	—

* Of all these varieties the Mwanza seed alone was harvested, yielding 1,660 lbs. per acre. Method of planting in rows 12″ x 12″. All plots were .06 of an acre.

R. J. LATHBURY, *Senior Agricultural Supervisor.*

APPENDIX M.

Report of the Agricultural Supervisor, Coast Area.

Staff.—Mr. A. G. Bailey was in charge from the 1st of January to the 30th of October, 1926.

I arrived here on September 11th and took over Mr. Bailey's duties on October 30th, 1926. The staff under control for the year was as follows :—

Mombasa—1 instructor, 1 apprentice.

Malindi—4 apprentices.

Kilifi—1 instructor, 6 apprentices.

Digo—1 apprentice.

Augmented at periods by a few part-time apprentices and casual labourers.

A large staff has been employed throughout the year owing to increased activities. The need for a training centre at the Coast in order to train instructors as at Scott Agricultural Laboratories and Bukura Schools has been keenly felt. Instruction to the present staff has lacked continuity since it can only be imparted during visits of officers to their particular areas.

Efficiency would increase to a marked degree could Coast boys be trained for two or three years either at a Coast training centre or at one or the other of the present centres, at the end of training being sent out to the Reserves as instructors on a yearly or two yearly agreement with fixed scale of pay and small yearly increments. This would obviate the frequent changes in staff which occur under the present system, whereby useful work is often delayed.

In spite of difficulties the progress made by the staff has been generally satisfactory.

Weather and Rainfall.

Short rains, 1925.—No rain fell during December and January and drought and heat continued up to 26th February, 1926. With the exception of the locations along the ridge running from Mazeras to Chonyi, a few river beds and low lying situations, the whole short rain maize crop of the Coast failed, even the crops on the Sabaki River failing. For the third successive season there have been no short rain crops in parts of the Digo district.

Long rains, 1926.—The first showers of the long rains for this year were recorded in Mombasa, on the 20th February, and were followed by heavy downpours. Showers were, however, very local, in the Mazeras, Kaloleni areas conditions were ideal, while north of Mambrui and in the Digo hinterland showers were light. Showers continued during July and August and there was no definite dry period between the long and short rains. Although sufficient in most districts, the long rains were insufficient north of Mambrui and in parts of the Digo and Kilifi districts. Detrimental high winds were experienced along the Coast in May.

Short rains, 1926.—The short rains broke on 21st September, 9.61 inches falling at Mombasa during the month. Rain did not continue satisfactorily however, falling off in October, increasing in November, showers were very local. Where shambas were cultivated and planted early and precautions taken to conserve moisture, fair crops will be obtained; where this was not the case crops will be very sparse or a failure.

Appendix I.—Rainfall. Mombasa, Sokoke, Kilifi, Gazi, Malindi.

Travelling.—2,713 miles were travelled by motor car and work in the Reserve occupied 170 days. The decrease in the number of days spent in Reserves was due to :—

(1) Illness of Mr. Bailey;

(2) Special duties, assisting in maize grading owing to depletion of grading staff by sickness.

Crops.—See Appendix II—Issues of Seed.

Maize—Long rains.—Good yields were reported in all districts with the exception of the Digo hinterland, north of Mambrui, in the Malindi district and around Bamba in the Kilifi district, along the Sabaki River yields were heavy. Heavy yields were also obtained along the Chonyi Ridge.

Short Rains.—The short rains being very local, good yield cannot be expected in all areas. In certain areas such as around Jimba, where maize was planted early, good crops have been obtained. In most areas, however, short rain maize is sparse. In the Digo hinterland short rain maize has again failed.

General.—Considerable attention has been paid to maize since it is the chief food crop of the people. A number of varieties have been tried with considerable success during the long rains and but little success during the short rains. Improvement has been undertaken on the lines of better cultural activities to increase yield and better seed issues. The problem presented appears to find solution in selection of

hybrids and breeding up from existing native maize until a quick-growing drought-resistant variety can be found suitable to Coast conditions.

Prices ruled from 12 Pichies for 2/- to 7 Pichies for 2/-.

Cotton.—Owing to the failure of seed to germinate, expectations did not run high. The failure was apparently due to the depredations by bollworm and *oxycarenus*. Information was received too late to obtain supplies of seed from Uganda. A considerable area was, however, planted in the Malindi district whilst a big decrease in area planted occurred in the Kilifi district. Good first pickings were obtained, though subsequent pickings will be small owing to lack of rain. Cotton purchased at Malindi up to 31st December amounted to :—

1st Quality	93,000 lbs.
2nd and 3rd Quality	15,000 lbs.
Some 28,000 lbs. 1st Quality at	10 cents.
65,000 lbs. 1st Quality at	9 cents.

Considerable dissatisfaction was expressed at the low price by native growers and a decrease in the area sown to this crop may be expected in 1927.

Perseverance with this crop is desirable since it grows well throughout most districts on the Coast.

Coconuts.—Native holdings still continue to increase but the manufacture of copra does not increase and still remains of poor quality. It will be noticed from Appendix III that there is an increase in the export of copra from Kilifi entirely due to a considerable area of a European holding at Sokoke coming into bearing. This plantation may be considered a model plantation and is of considerable educative value not only to planters but also to natives would the latter but read its lesson.

Prices—

Native Copra : 6/- per frasila, 36 lbs.
Coconuts : 5/- to 8/- per 100.
Copra : £30/15/0 per ton.
,, Mombasa : 480/-.

Disease and Insect Pests.—Amongst diseases and insect pests brought to notice were :—

1. Coconut beetle (*oryctes monoceros*).

2. Gummosis and excessive nut fall.

Simsim.—Issue of simsim seed have been made in all districts and a noticeable feature of the work undertaken has been an increase in areas sown to this crop. It has been successful both as a catch crop and a short rain crop providing a useful increase in revenue for natives.

Prices—

From 2½ Pichies for 2/- for the black variety;

From 3 Pichies for 2/- for the white variety.

A considerable increase is expected in 1927. Black simsim is held in favour around Takaungu and in the Malindi area, whereas the white variety is preferred from the Railway south to the Tanganyika border.

Rice.—Good yields of rice have been obtained. An increase of Shs. 1,206/- is noted in exports from Kilifii. Along the Sabaki River and Vanga areas good yields have been obtained.

Both Swamp and Upland varieties are grown. The Upland variety being grown on the heavier soils in the area from the sea to a line 20 miles inland, where rainfall ceases to be adequate.

Swamp varieties have been grown at Vanga and also at Goshi on the Sabaki River successfully.

Yield of paddy up to 2,045 lbs. per acre, proportion of grain to paddy 66 per cent., have been reported.

Endless new varieties arise at Vanga by a process of selection, the most popular being (1) Manicora, (2) Maria, (3) Sifala, (4) Afaa, (5) Nondo; Afaa reported to have the best flavour but the lowest yield.

Canadian Wonder Beans.—This crop has been issued in small quantities in certain areas and is finding considerable favour amongst natives. An increase may be expected in 1927.

Cassava.—This crop still remains the famine crop of the Coast. Good yields have been obtained in most districts.

Tobacco.—This crop grows well all over the Coastal area as well as inland. Some leaves measuring 18 inches long and 10 inches broad. The majority is made into snuff. Some tobacco is sold as such in bundles weighing 1 lbs. to 1½ lbs., costing 1/-.

Livestock and Ghee.—Disease was reported amongst cattle in the Bamba district and symptoms indicate the presence of fly. The livestock held by natives in the Coast districts is small, due to this cause. Disease has, however, been less prevalent than in previous years.

Hides and Skins.—Hides and skins still continue to remain poor in quality, being sundried, although instruction in drying them under shade has been given in many locations.

According to information obtained some 800,000 hides from different districts up-country have been exported from Mombasa during the year as against 900,000 in 1925.

Ghee.—The locally prepared ghee industry continues to progress and prices for Mariakani and Rabai ghee were 72/- to 52/- per frasila.

Instructional Work in Native Reserves.

Instruction has been given by members of the native staff to natives on their own shambas, and by means of demonstration shambas which are now entirely worked by paid apprentices and instructors under supervision, except in the case of Waa, Ganda and Mambrui, where all work is done by pupils of the adjacent schools. Assistance has been rendered to Mission Schools and good work has been accomplished by means of school gardens. It is hoped that this form of instruction will be increased. The larger shambas were situated at Mariakani, Ganda, Mambrui, Kaloleni, Rabai, Ribe, Ganzi, Takaungu, Jibana, Mwavumbo, Samburu, Kinango, etc. Barazas were held when travelling with administrative officers and attendances were good. Instruction was given by officers when on safari during all times of the year.

Experimental Work.

Trials of two different varieties of cotton from Sudan were made, both varieties giving good yields. The Dongola cotton is the more satisfactory.

Onions (*Bombay*).—Good yields were obtained at Mariakani and it remains to be proved whether this crop can be taken up by natives.

Maize.—White Pearl and White Cango proved suitable as a long rains crop but were found unsuitable for short rains.

Native Agricultural Shows.

Shows were held in the Kilifi, Malindi and Digo districts at Ganzi, Malindi and Kwale respectively. The Show at Ganzi, which bid fair to be a record, was spoilt by heavy rain, in spite of which some 600 exhibits were shown, many exhibits were damaged or swept away *en route*, some lives were lost in crossing the rivers. The show at Malindi was held in the school, kindly lent by the Education Department owing to rain. Kwale was favoured with fine weather and a successful show was held. The continuance of these shows is strongly advocated as a useful means of agricultural propaganda.

Communications.

With improvement in communication around Mariakani an increased trade is being established for native products. The Trading Centre at Myenzeni is being increased. With communications at present as they are the large area of the Sabaki River remains comparatively untapped; when communications become better in this area a large surplus of maize, rice, etc., should be forthcoming, forming a considerable

revenue to natives, alleviating high prices and lack of food in other districts. With better communications and a ready market a stimulus would be given to natives to increase their holdings and follow better methods of cultivation and planting.

Conclusion.

The long rains were more favourable during the year than in 1925, but it is difficult to make reliable comparisions between agricultural conditions owing to the export of native foodstuffs being under control throughout the period under review. A great amount of assistance was rendered at all times by administrative officers and due to their enthusiastic co-operation progress has been made.

H. J. TAYLOR,
Agricultural Supervisor

APPENDIX I.

RAINFALL—COAST—1926.

STATION	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.	Total
Sokoke ..	—	—	4.43	7.00	7.24	10.77	5.66	1.92	12.42	1.07	1.55	3.38	55.44
Kilifi ..	.07	.06	.63	5.46	7.92	5.46	3.57	1.20	6.68	.74	2.48	2.46	36.73
Gazi ..	—	.30	4.98	11.30	8.80	8.50	3.40	3.13	4.77	1.60	4.23	.75	51.86
Malindi	—	—	1.89	11.23	15.44	8.87	4.23	1.22	13.54	.64	1.76	.50	59.32
Mombasa	—	.25	4.44	4.09	7.24	5.88	4.01	2.38	9.61	.76	3.46	.75	43.05

APPENDIX II.

SEED ISSUES—COAST DISTRICTS—1926.

District	Rice	Maize	Cotton	Simsim	Beans
Digo	4	18	23	18	2
Malindi	—	—	250	30	5
Kilifi	—	8	—	5	—
Mombasa	—	1	10	2	—

APPENDIX III.

COMPARATIVE STATEMENT OF EXPORTS—KILIFI 1925—1926.

	1925		1926	
	Quantity cwts.	Value shs.	Quantity cwts.	Value shs.
Maize	13,661	80,489	10,469	70,574
Paddy	166	1,699	41	438
Millet	528	3,462	1,241	1,430
Beans	1,291	12,961	449	8,172
Ghee	63	601	3	144
Fresh Fruit ..	..	791	..	929
Tobacco ..	7	360	3½	242
	tons		tons	
Sisal	968	1,920,375	1,217½	915,993
	cwts.		cwts.	
Simsim	1,741	35,042	2,755	43,533
Copra	337.2	8,640	17,872	9,232
Coconuts ..	..	8	..	..
Hides	..	650	..	2,310
Skins	..	1,564	2,530	2,960
Rubber ..	2,912	2,650	1,985	3,530
Raw Cotton ..	..	..	4,696	160
Rice	..	..	104	1,260

CTORATE OF KENYA FOR THE YEAR 1926.

Registered Number.	Humidity			Wind Force	Amount of Cloud.	Rainfall					
	Departure of Wet Bulb	Vapour Pressure	Percentage			Total Amount	Greatest fall	Date	No. of days rain.	Average	Period of years.
	°	ins.	%	0.12	0.10	ins.	ins.		No.	ins.	No.
5	2.5	917	87	1.7	—	45.94	5.70	1st May	58	36.93	19
23	—	—	—	—	—	59.16	1.60	21st Feby.	201	47.91	4
1	3.5	551	79	—	—	52.27	3.06	7th April	110	46.08	24
6	4.1	442	75	2.3	6.6	45.24	2.74	17th April	160	46.94	7
21	3.0	420	82	—	—	50.89	4.07	22nd April	122	58.99	5
5	—	—	—	—	—	48.74	3.55	21st April	113	48.44	16
5	4.2	388	76	—	—	54.98	2.70	5th May	203	54.32	19
10	—	—	—	—	—	39.58	3.40	22nd April	105	36.68	10
14	—	—	—	—	—	22.60	1.11	12th April	81	24.94	13
5	6.1	462	69	—	3.8	77.20	2.32	17th Sept.	221	65.55	4
3	6.0	417	67	—	3.3	89.39	1.69	9th April	216	74.27	14
3	—	—	—	—	—	77.49	2.06	29th Aug.	221	73.21	14
18	6.6	426	65	1.05	2.79	51.17	1.86	17th July	147	41.36	8
21	8.2	430	57	—	—	60.47	1.89	11th May	175	51.11	7
10	2.6	435	79	—	—	66.36	1.61	8th Nov.	173	64.86	21
4	5.8	515	69	—	—	65.23	1.90	3rd Aug.	177	55.29	3
6	5.1	502	74	—	—	40.19	2.75	4th Dec.	70	36.43	32
23	3.6	418	76	2.3	7.1	38.01	2.96	16th April	85	38.24	4
2	5.3	431	72	1.3	6.4	36.28	2.11	16th April	93	32.12	3
9	4.5	486	78	1.7	6.7	32.15	2.08	21st April	84	35.90	11
15	4.3	523	75	—	—	41.37	1.89	14th Sept.	76	37.43	5
7	4.5	816	79	—	—	43.05	4.62	23rd Sept.	94	46.74	36

APPENDIX P.

Precis of the Reports of the Veterinary Department, and of Officers-in-Charge of different Branches of the Department for 1925 are given hereunder.—(*Omitted from Annual Report, 1925.*)

VETERINARY DEPARTMENT.

Administrative and Executive Division.

The total expenditure for the year was £36,347, an increase of £5,783 over the previous year. The revenue (including that derived from serum issued from the Veterinary Laboratory, and valued at £19,440) amounted to £24,520, an increase of £12,748 over 1924.

The total expenditure on Veterinary Services, including that on the Veterinary Research Laboratory, was £64,081 and the revenue derived from both divisions was £31,063. The increased revenue is due to the response of native stock-owners to the efforts of the Veterinary Department in educating natives as to the value of inoculation methods, also to their greater prosperity which enables them to pay the fees. In his report the Chief Veterinary Officer makes interesting observations showing the enormous saving to stockowners through immunisation.

The following statement shows the number of outbreaks of the three most serious diseases which occurred in the settled areas during the last four years :—

	1922	1923	1924	1925
Rinderpest (No. of farms infected)...	14	38	211	145
Pleuro-pneumonia (No. of outbreaks)	7	4	13	14
East Coast Fever (No. of outbreaks in "clean" areas)	12	6	19	13

The causes of these outbreaks remain the same as in previous years, *i.e.*, chiefly extensions of centres of infection from Native Reserves.

Rinderpest.

The new Rinderpest Service operating in the "settled" area was inaugurated and has carried out double inoculations successfully throughout the Uasin Gishu and Gilgil districts.

New services were provided at additional Veterinary Stations for the inoculation of native-owned stock.

The following tables give the figures of rinderpest inoculations, (*a*) for 1923 and 1924 which should be compared with (*b*) for 1925, but for which certain additional data are available :—

(*a*) 1923 and 1924.

	1923	1924
In Settled areas	15,523	41,326
In Native Reserves	7,935	1,409
At Veterinary and Quarantine Stations (including native-owned and trade stock) ...	5,126	17,458
Total ...	28,584	61,193

(*b*) 1925

	Double inoculations.	Virulent blood tests.	Serum alone.	Mortality.
In Settled areas ...	41,721	615	1,201	1,284
By Rinderpest Service in settled areas ...	10,381	4,428	2,538	3,691
At Veterinary and Quarantine Stations ...	106,186	5,456	4,072	2,075
Native areas	2,755	3,908	1,627	346
Total ...	161,043	14,407	9,438	4,074

During the year 1925, 185,888 head of cattle were double inoculated or tested against rinderpest, or inoculated with anti-rinderpest serum, as compared with 61,193 head of cattle in the year 1924.

The enormous increase, particularly in that of native-owned stock, is remarkable, and while these stock are protected against the disease and their value thereby enhanced, the Government has derived considerable revenue from the fees levied.

Considering the conditions under which some of the inoculations have to be carried out, the average mortality rate of 2.2 per cent. in 1925 cannot but be regarded as very satisfactory.

PLEURO-PNEUMONIA.

The policy adopted a few years ago in issuing vaccine free of charge has placed in the hands of European stock-owners the means of protection against this disease, and experience shows that it was fully justified.

No less than 295,320 doses of pleuro-pneumonia vaccine were issued by the Veterinary Laboratory during the year.

The number of outbreaks in the settled areas, 13 in 1925, was the same as in the previous year. There were no extensions from those outbreaks, all of which were traced to native-owned stock that had not been inoculated. At Veterinary Stations in the Native Reserves 44,102 were inoculated with pleuro-pneumonia vaccine.

East Coast Fever.

Towards the end of 1925 and up to the time of writing there has been a serious spread of East Cost Fever in the North Nyeri-Laikipia and in the Mau Summit-Molo areas. The introduction into these areas of squatter labour, usually accompanied by stock, may be a factor in the creation of the fresh centres reported, and it is believed that the disease existed on some of the newly reported centres, before it was recognised by farm owners. Experience rather shows that at least in certain parts of areas hitherto regarded as clean, ticks, which carry East Coast Fever infection, may find a suitable breeding ground, and there is little doubt but that if cattle movement regulations calculated to prevent the spread of the disease were not strictly enforced the disease would become extensively spread into areas hitherto known as "clean." A problem is presented in the best methods to be adopted to deal with the disease under the conditions which obtain. Circumstances have not yet permitted the Cattle Cleansing Ordinance of 1920 to be applied, and it is considered that simultaneously with its application fencing would require to be introduced. It is doubtful whether the state of development of the Colony is yet ready for that introduction.

The Agricultural Chemist again reports a large percentage of cattle dips at strengths which are seriously and dangerously wrong.

Trypanosomiasis.

There has been no marked change in the position, but not infrequently sporadic outbreaks of the disease occur, causing anxiety and some losses to stockowners. A good deal of information has been collected as to the presence of tsetse fly and the occurrence of trypanosomiasis in parts of this Colony, but the present staff are unable adequately to carry out the entomological surveys which necessarily occupy a considerable time. The Entomologist has co-operated with the Veterinary staff in determining places within which tsetse fly is found or is likely to be found. There is no evidence to show that "tsetse fly belts," as hitherto known, are extending. Cases in which trypanosomiasis have occurred on farms adjacent to tsetse fly areas are not accompanied by heavy mortality, and it is believed that the fly is introduced by big game in the course of their migrations. The

study of tsetse fly and of trypanosomiasis is engaging the attention of the Committee of Civil Research. That must precede the measures to be adopted for the eradication of tsetse in the extensive areas where it is known to exist. These measures are likely to prove very costly, and the settlement of the country so cleared will require to be carried out simultaneously and maintained, but though difficult of treatment and solution, the subject is one of far reaching importance to the development of enormous areas of productive land in Central and East Africa.

Other Diseases.

Anthrax showed a falling off in recorded outbreaks, the figures being 38 for 1925 against 50 in 1924. There was also a slight decrease in the quantity of anthrax vaccine issued from the Veterinary Laboratory.

Blackquarter continues to cause losses. The disease is widespread and in cases where it occurs on a farm stockowners should regularly use the vaccine issued by the Veterinary Laboratory.

With the advance of dairying, diseases causing heavy mortality among calves are becoming more common. A factor is undoubtedly the lowered vitality of the calves due to management unsuitable to calfhood, and although protection may be afforded through the use of vaccines it has to be recognised that a suitable and nutritive diet is essential and that calf sheds must be sanitary.

Equine diseases call for no special comment.

Veterinary Stations in Reserves.

In order to provide for additional inoculation services, new stations have been opened, and they afford an opportunity for educating natives as to value of inoculation methods and of teaching them in the work. The results have so far been encouraging. A further development is contemplated in the provision made in the 1926 Estimates for the establishment of a Central Veterinary Training Depot where, in conjunction with work on East Coast Fever immunity, facilities will be afforded for further training. Likewise the Africans attached to the special Rinderpest Service have opportunities for gaining some insight into stock breeding practice on European farms, which cannot but be of value to them. Veterinary Stations for native-owned stock are now established at Bungoma in North Kavirondo; Kingwall in the Nandi Reserve; Timboroa to serve the Kamasia, Elgeyo and Marakwet Reserves; Kibigori serving Central Kavirondo; and Isiolo serving the Northern Frontier District. Steps are being taken to establish a Veterinary Station at Mariakani to serve the coastal area. The volume of work done is reflected in the returns of stock passing through these Stations, as already quoted.

Slaughter Stock.

Some reference has already been made to the supply of stock for slaughter purposes. The abattoir returns for the last three years are as follows :—

	1923		1924		1925	
	Nairobi	Mombasa	Nairobi	Mombasa	Nairobi.	Mombasa
Cattle ...	8,933	2,962	11,085	4,061	13,331	5,337
Sheep and Goats	19,893	7,816	20,212	3,360	19,248	18,598
Pigs ...	1,366	...	943	...	672	...

Note : The Nairobi returns include slaughtering at Mbagathi up to 28/2/26.

The increase in cattle slaughtered at Nairobi in 1925 does not necessarily mean a corresponding increase in weight of beef, as it is known that, on account of the shortage of supplies and droughty conditions in pastoral areas, small and lean cattle were slaughtered in large numbers.

The decrease in pigs slaughtered for fresh pork confirms the general shortage of supplies of pigs.

The percentage of beef carcases condemned on inspection at the Nairobi abattoir was 3.5 per cent. in 1923; 5.7 per cent. in 1924; and 4.7 per cent. in 1925, the chief cause being measles.

Brands Ordinance.

175 brands were registered during the year, none were transferred and none cancelled. There has been some increase in the issue of " S " brands stipulated under the Resident Native Labourers Ordinance but the position remains unsatisfactory. Proposals were made for consideration to be given to the advisability of making cattle branding compulsory in the alienated areas and that was recommended by the Stock and Produce Theft Committee. With the additional clerical assistance provided in the 1926 Estimates an endeavour will be made to bring the Brands Directory up to date.

DIVISION OF VETERINARY RESEARCH.

Staff.

Mr. R. Daubney, M.R.C.V.S., M.Sc., was appointed to fill the vacant post of Assistant Chief Veterinary Research Officer and arrived in Kenya to take up his duties on July 10th, 1925.

Two officers arrived on first appointment to fill the vacant Laboratory Assistant posts.

Finance.

The total expenditure for the year was £27,734 and the revenue directly secured amounted to £6,543, excluding that of anti-rinderpest serum of the value of £19,440 issued to the Executive Division for use in the field and shown under "Testing, Dipping Fees, etc."

Other products valued at £1,478, chiefly pleuro-pneumonia vaccine, were manufactured and issued free of charge. The total shows a reduction in comparison with 1924; this is owing to the cost of production of pleuro-pneumonia vaccine being estimated at 10 cents per dose as against the previous estimate of 30 cents per dose.

Preparation of Laboratory Products.

The amount of serum, vaccines, etc., prepared and issued during 1925 are shown in the tabulated forms to be found in the report of the Chief Veterinary Research Officer. Therein is reflected an enormous amount of work performed by the institution.

Technical Routine.

The technical routine work included the preparation of anti-rinderpest serum and various vaccines, the examination of smears, specimens, etc., besides which, as the result of research, technical work increased and necessitated the detailing of laboratory assistants for routine work at the expense of research, 9,828 specimens were submitted for examination; these included blood samples submitted for serum diagnosis tests for bovine pleuro-pneumonia.

TECHNICAL RESEARCH.

Diseases of Cattle.

Rinderpest. Several obscure points which arose in connection with rinderpest immunisation operations in the field were investigated and elucidated, and the cause of non-reactions which occurred in practice on two occasions, was determined. Tests were made to determine the potency of Tanganyika anti-serum for low grade cattle of this Colony.

Redwater-Gallsickness Immunisation. Imported cattle undergoing immunisation at the Quarantine Station, Nairobi, are kept under daily veterinary observation, temperatures are recorded daily, and smears submitted daily for microscopical examinations; it has thus been possible to follow closely the results of inoculation and to control the reaction to redwater with trypanblue, if necessary.

The method of immunisation consists of an original inoculation with vaccine (blood) containing a mild strain of redwater, and gallsickness (*anaplasma centrale*). When the reaction to these infections has passed over, a second inoculation with blood containing a more virulent strain of redwater and gallsickness (*anaplasma marginale*) is given.

Observations show (1) that the original inoculation produces *variably* a reaction to redwater and *invariably* to gallsickness (*anaplasma centrale*) and that cattle which give no apparent reaction to redwater may react to the more virulent strain, (2) that although the *anaplasma centrale* reaction gives sufficient protection against death from the more virulent strain (*anaplasma marginale*) a marked reaction to the latter sometimes occurs.

The results of immunisation have been very satisfactory and experience has shown that the above-mentioned method gives protection against severe reactions and mortality to redwater, and protects against the virulent gallsickness (*anaplasma marginale*), when the immunised cattle are exposed to natural infection.

BREEDING AND REARING OF REDWATER-GALLSICKNESS VACCINE PRODUCERS.

Hitherto, cattle for vaccine producing purposes were purchased in Great Britain, which was found to be costly. Redwater-gallsickness vaccine producers are now bred from the laboratory breeding stock and reared at the laboratory.

EAST COAST FEVER.

The following work was carried out, viz. :—

Immunisation of weaned calves.—The average percentage of mortality from East Coast Fever and complications and other causes, totalled 57.4 per cent.

Observations on the death-rate from East Coast Fever and complications in (1) non-inoculated weaned calves exposed to natural infection, and in (2) non-inoculated unweaned calves exposed to natural infection.

The percentage of mortality in the former was 90 per cent.; in the latter 100 per cent.

Immunisation of cattle, other than calves, recovered from redwater and gallsickness.—Average percentage of mortality from East Coast Fever and complications and other causes, totalled 25.5 per cent.

Immunisation of cattle other than calves not recovered from redwater and gallsickness.—Percentage of mortality from East Coast Fever—5 per cent.; percentage of mortality from anaplasmosis, redwater and spirillosis—25 per cent.; total mortality—30 per cent.

The best results in field immunisation are anticipated in cattle, other than calves, which have recovered from redwater and gallsickness provided they are in a suitable condition and the grazing is good, and immunisation is carried out under veterinary supervision.

The higher death rate in calves was due to unfavourable grazing conditions which existed at time of exposure and to a recurrence of redwater and complications with spirillosis, which were responsible for a loss of condition and lessened resistance; better results are anticipated under more favourable conditions.

Observations were made on the nature of the immunity conferred by natural infection in inoculated cattle and non-inoculated cattle.

In the former, re-infection to natural infection occurred on re-exposure in 6.9 per cent. approximately, of the total number re-exposed, viz.: 86. In the case of the latter, re-infection on re-exposure occurred in 10 per cent. of the total re-exposed, viz.: 10.

The fact that cattle which have recovered from a natural attack may, in some cases, again contract the disease is an important point in the control of the spread and eradication of East Coast Fever.

Sterility in Cattle.

Various pathological conditions were found in a number of non-breeders slaughtered at a local butchery; agglutination tests were positive for contagious abortion in a percentage of the tests made.

Mortality among Calves.

An exceedingly high mortality occurs in calves on some dairy farms; smears submitted on various occasions frequently showed infection with redwater or gallsickness (*anaplasma marginale*).

Arrangements were made with the manager of an estate to vaccinate calves at birth with redwater-gallsickness vaccine, and to keep careful records of the results; the evidence obtained was not sufficiently conclusive in support of these infections being in every instance responsible for the mortality and the existence or co-existence of some other cause was suspected.

Cultural examination of the intestines and organs resulted in the detection, in some instances, of an organism of the Paratyphoid-Gaertner group, and a vaccine was prepared and is being issued for experimental use.

The relationship of this infection to the mortality from redwater and gallsickness is receiving consideration.

Sheep Diseases.

The existence of a specific lung infection in sheep in the Laikipia district has been suspected for some time and investigations in connection therewith were carried out *in loco* and material collected for further work at the laboratory.

Bacteriological examination resulted in the isolation from the lesions of several organisms, the specificalness of which, for the diseases, is being determined.

East African Swine Fever.

Attempts at attenuation by passing the virus through small laboratory animals (guinea pigs and rabbits) were unsuccessful. The probability of *haematopinus suis*, the common louse of the pig, being a carrier was investigated. The results were negative.

Further attempts to attenuate the virus were carried out with promising results. Several pigs which were inoculated gave a definite reaction to swine fever and recovered, and it will now be necessary to determine whether the reaction produces immunity against natural infection.

Diseases of Avians.

The species of the bacillus isolated from a number of cases of Kikuyu Fowl Disease, from various outbreaks in Kenya, was determined, and with the result that the organism, in each case, was proved to belong to the genus *Eberthella*, species *sanguinaria*, the type species of which is *E.typhi* (Eberth), the causal organism of typhoid fever of man.

Parasitic Worms.

A preliminary survey of the parasitic worms of domesticated animals in Kenya has been undertaken.

The parasites recorded include one new species and several new records of parasites from Africa.

The opportunity afforded by an extensive outbreak of hook-worm (*bunostomum trigonocephalum*) infection was taken to carry out experiments in anthelmintic treatment; the results of these observations will be published later. There is evidence that serious losses have been occurring in flocks of lambs as a result of infection with small nematodes of the Trichostrongyle group; the question is being studied in detail.

AGRICULTURAL CHEMISTRY.

The Chemical Officer was absent during the greater part of the year, leaving the staff at one unit and a laboratory assistant.

In connection with the mealie bug destruction and general soil investigation, 2,256 miles of extra departmental travelling were performed, in course of which four farmers' meetings were addressed. The total attendance at these addresses was about 200.

In the laboratories 664 samples were examined in the course of routine and investigational work. Of these samples 475 were samples of dip.

The results of the analyses of dips do not indicate any general improvement in the maintenance of dip strength. There was a slight increase of samples dangerously incorrect. Such a condition is inexcusable.

The division has taken an active part in the mealie bug campaign. A spray was evolved, and it has proved efficacious. In collaboration with the Entomological Division an ant repellent has been prepared.

Manuring is a subject which is becoming of more and more importance in the agricultural practice of Kenya Experiments on coffee and on maize have been started. In addition, experiments to determine the value of the various types of fertiliser available have been commenced at the Scott Agricultural Laboratories. Several minor experiments have been planned for farmers from which valuable data may accrue.

It is considered that a rotation system of agriculture in which green manure plays a part will, in the near future, become essential. In order to accumulate data regarding the value of various legumes as green manures, experiments have been started at the Scott Laboratories and subsidiary trials have been arranged in various parts of the Colony.

During tours in the farming districts the Chemist has made important observations and collected information with regard to soil conditions, which should prove useful in the investigations contemplated as soon as circumstances allow.

The Chemical Laboratory has been much handicapped in its work owing to the absence of gas installation.

ENTOMOLOGY.

4,950 miles were travelled by the Entomologists on duty, comprising inspection of plantations, field experimental work, meetings and investigation into outbreaks of pests.

Routine Work.

The increase noted in last year's report has been maintained. The strict examination of imports has led to several pests being stopped. The importation of plants and seed is governed by the permit system, by which the country of origin, the consignee, varieties, and destination are known, and any consignment for which no permit has been first obtained is liable to be severely dealt with. By this means it is possible to stop or modify any order sent overseas and also to trace any introductions.

INSECT PESTS OF THE YEAR

The outstanding feature of the year under review has been the work done in connection with the control of the coffee mealie bug which was reported last year as having spread to an alarming extent. Investigations and experiments engaged the close attention of several officers of the department.

A great variety of sprays and repellents were tried with more or less success, but were considered to be inadequate.

A special study of natural enemies of the mealie bug was made by Mr. Kirkpatrick and the conclusion come to was that, provided the ants were kept from association with the scale, there were sufficient (some 30 species) enemies to control the mealie bug naturally. The problem then resolved itself into keeping the ants off the bushes by some mechanical device as repeated experiments had shown that poisons were of little use against the ant. The bushes are banded with a strip of americani soaked in " Cresoto." Beneath this band is placed a thin band of cotton wool to prevent the ants climbing up behind through the cracks in the bark. This has been successful in keeping the ants off for from four to five months, and has withstood climatic conditions. The experiments are still continuing.

The Entomologist represented Kenya at the Imperial Entomological Conference held in London in June and also at the meeting of the Advisory Committee on Silk Production within the Empire.

MYCOLOGY.

The Mycologist was absent from Nairobi on duty for 62 days, during which some 4,500 miles travelling was done and about 120 visits to farms were made.

The most important events of the year were the discovery of the presence of mosaic disease of sugar cane and " head " smut of maize in Kenya. The former was the subject of extensive field investigation and necessitated the introduction of quarantine measures.

Further research work was carried out in connection with the coffee berry disease and experiments on additional lines of control were inaugurated. Work was continued on a disease affecting coffee and other seedlings and on a disease of native mtama. In co-operation with the Department of Scientific and Industrial Research, experiments in the exposure of various fabrics to climatic conditions were carried out. Field observations were also made in connection with a blackening of sisal leaves after cutting and on the occurrence of a destructive parasitic weed affecting maize, sugar cane and mtama.

Enquiries dealt with regarding plant diseases covered a range of 33 different hosts. Several diseases not mentioned above, were recorded for the first time in Kenya.

Two bulletins on maize and coffee diseases respectively, and three Press articles were published during 1925.

A considerable number of authentically named specimens, including many grasses, were added to the botanical herbarium